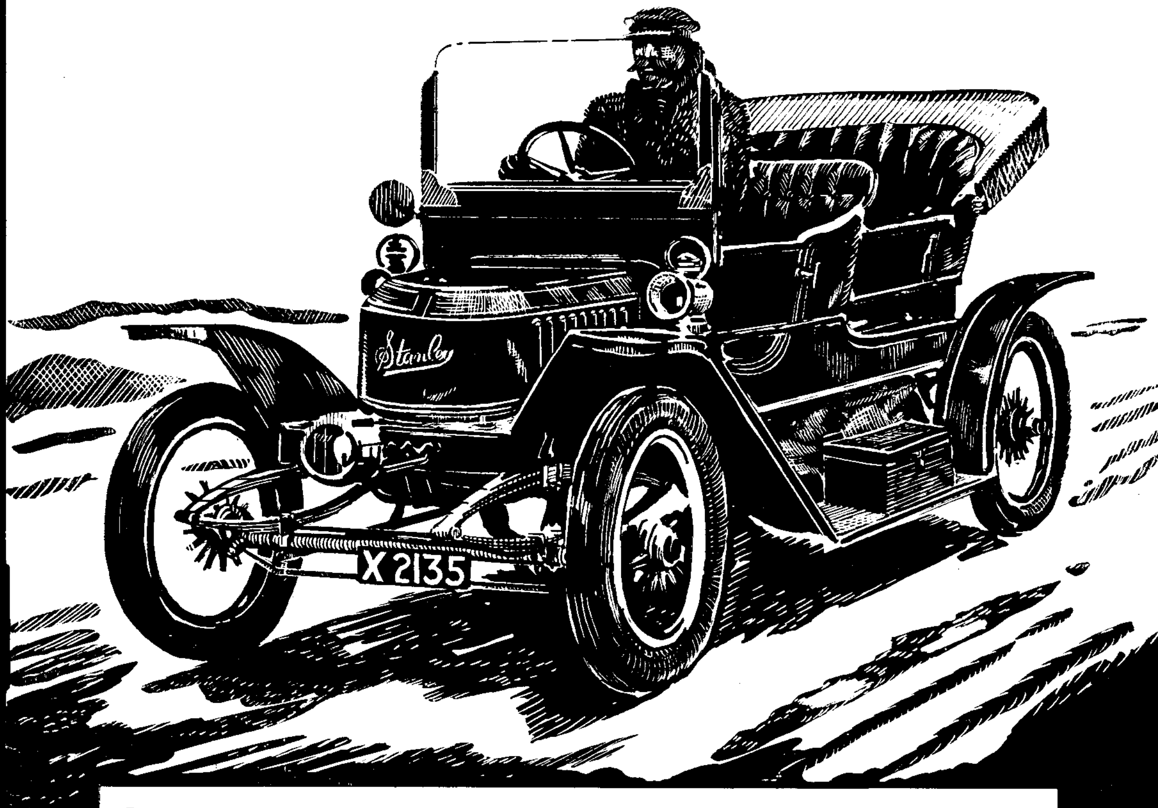
THE MODEL ENGINEER



Vol. 96. No. 2390 THURSDAY MARCH 13 1947 9d.

THE MODEL ENGINEER

Percival Marshall & Co. Ltd., 23, Great Queen Street, London, W.C.2

SMOKE RINGS

To Our Subscribers

WE should like to make it quite clear to our regular subscribers that as the result of the official suspension imposed on all weekly periodicals during the fuel crisis, there will be a gap of two issues in their copies. Regular publication was resumed with our issue of March 6th, and all postal subscribers will have their subscription dates extended by two weeks to make good the shortage in the period covered by their payments.

To Exhibition Secretaries

I WOULD like to whisper a word in the ear of club secretaries who, from time to time, send us photographs of their local exhibitions. The type of photograph usually submitted for publication in THE MODEL ENGINEER, shows a general view of the room in which the show was held, or a portion of the room, showing one or more tables on which a number of models are displayed. While a picture of this kind does give an idea of the extent and character of the exhibition, it is not of particular interest to our readers in general, for the models appear on much too small a scale for their special features to be seen. It would be much better to send us a few good individual photographs of the best models in the show, with brief notes of their salient points of interest. Every reader of THE MODEL ENGINEER can appreciate a good model, and in these local shows there are always one or two outstanding examples of good craftsmanship or original design which we should much like to illustrate for the advantage of all concerned. I am sure the prestige of local societies would be enhanced by this more definite presentation of the skill and ability which is characteristic of their particular membership. So, please, Mr. Secretary, more good photographs of your best models, rather than general views of the show as a whole.

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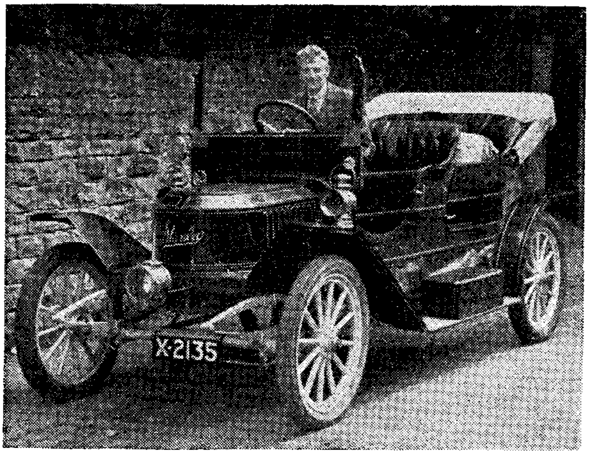
The Shand-Mason Fire Engine

I THINK many readers would like to join with me in complimenting Mr. H. S. Goodman on his excellent model of a Shand-Mason fire engine, as described in our issue of February 6th. Not only is it a good model, but a fine piece of work, having regard to the builder's age. I was particularly interested in his reference to the work of the Coates brothers, whom I met in the early days of THE MODEL ENGINEER. They were then living at Carshalton, and were working on some models for the Science Museum. If I remember correctly, these included another fire engine, a triple-expansion marine engine, and a sectional model of a L.S.W.R. Railway locomotive. These brothers were craftsmen of a very high order, and I would especially recommend readers who may visit the Science Museum at any time to look at their models and note the accuracy and completeness of their work.

Our Cover Picture

FOR our cover illustration this week our staff artist has chosen the famous Stanley steam cars, of earlier motoring days as his subject. No doubt many of our readers will remember their smooth silence and acceleration which contrasted so strongly with their petrol-engined contemporaries, and in fact their flexibility has yet to be equalled. The drawing was based on a photograph, reproduced on this page, sent to us by Mr. Leonard Taylor, "The Bryn," Nore Road, Portishead, Somerset of his 1911 Stanley steamer.



An Eastbourne Project

I HEAR that the Eastbourne Corporation have under consideration the laying-down of a passenger-carrying miniature railway as one of the items in a programme for the attraction of visitors in the summer season. Go ahead Eastbourne, we are all for it!

Good Advice

THE following quotation from the writings of the late William Morris, the well-known humanitarian and social philosopher, appeared in the *Daily Express* during the fuel crisis. It seems peculiarly applicable to model engineers:—"If these hours be dark, at least do not let us sit deedless, thinking the common toil not good enough for us, and beaten by the muddle. Rather let us work like good fellows trying by some dim candle-light to set our workshop ready against to-morrow's light." I can well imagine that many of my readers have been frustrated in their hobby by the recent appalling weather conditions, but I hope that with a more genial temperature, and a glimpse of the sun, their workshop production has received fresh impetus and enjoyment.

The late L. M. G. Ferreira

IT is with very much regret that I have to record the passing of Mr. L. M. G. Ferreira, a valued personal friend for many years, and one of the outstanding figures in the model engineering world. Mr. Ferreira joined the Society of Model and Experimental Engineers as long ago as 1901 and took a very active part in its affairs, filling many of the executive offices and at one time was its President. He was a pupil in the Bow Works of the old North London Railway, where many clever engineers received their first technical training, including Mr. George Gentry and Mr. F. E. Powell, both so well known to MODEL ENGINEER readers. Ferreira was an engineer of exceptional experience and practical ability. He was one of those rather rare people to whom engineering becomes a second nature; he could solve technical problems as much by instinct as by his wide technical knowledge. He was a member of the Junior Institution of Engineers and for some years enjoyed membership of the Institution of Civil Engineers. Though primarily trained as a locomotive engineer, he became one of the leading authorities in this country on the electrical signalling of railways, and while on the staff of the well-known Siemens Company he had much to do with the signalling of the Great Western system, laying out in particular, the complicated installation at Snow Hill, Birmingham. He invented many of the most efficient instruments now employed in railway signalling. As a model engineer he earned much commendation for his own workshop achievements, including a fine undertype engine and boiler, and a most efficient steam launch. When he lived at Henley-on-Thames this launch was a frequent sight on the river towing a skiff laden with his passenger friends. But apart from his own model making Ferreira will be gratefully remembered in the ranks of the S.M. and E.E. for the helpful advice always so willingly placed at the disposal of the members, and for his services as a judge in the various club competitions. For several pre-war years he was my own chief colleague in judging the Competition Section at the MODEL ENGINEER Exhibition, and no one could express a more competent and well-informed opinion of the merits of any engineering model or piece of workshop equipment. He was as keen to recognise and praise good work as he was critical of faulty design or craftsmanship. He has left a legacy to model engineering by his design of the "Cert" injector, which, when it had proved its efficiency in his own experimental workshop, he passed over to Messrs. Stuart-Turner Ltd., by whom it is now marketed. Since the outbreak of the last war Ferreira lived quietly in retirement at Hove making an occasional appearance at the meetings of the Brighton Society. His helpful and cheerful influence was felt among model engineers in many quarters, and the hobby as well as his personal friends will be the poorer for his passing over to a new world.

Percival Marshall

*AUTOMATIC STEERING
FOR MODEL STEAMERS
By Lieut.-Colonel A. G. Bates

EXCEPT for the Weston relay, which is an old-fashioned moving-coil pattern with large horseshoe permanent magnet, all are of standard telephone type, with magnets re-wound where necessary to operate on 6 volts. In the case of Nos. 7 and 8 it was desired to keep the operating current which has to be handled by the Weston contacts as low as possible and they now take 7 mA only. None of the others are above 20 mA, except No. 4, which, being a series relay, is wound for minimum resistance. It was found advisable to shunt the Weston contacts by anti-sparking resistances and condensers of 2,000 ohms and 0.1 MF respectively. Little bother has been caused by relays, in fact the ship has been out on three days and in spite of the jolting in transit no adjustments have been needed.

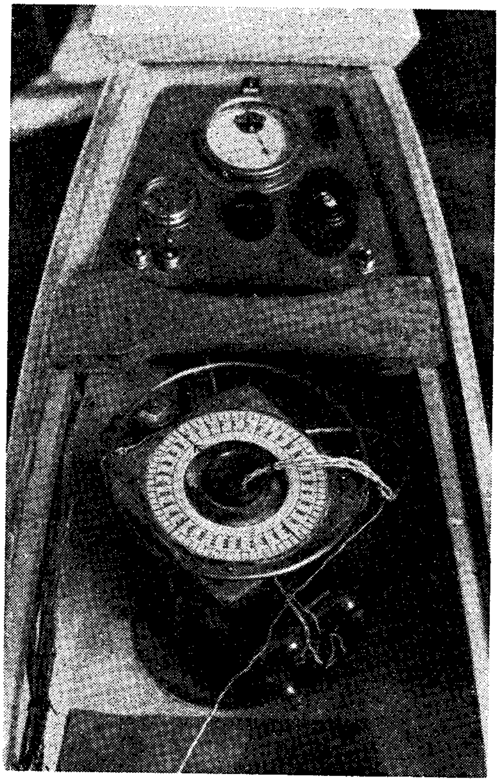


Fig. 4. Forward end of ship, showing test and control panel at top, and compass below

Compass

Internal stops are fitted to limit the movement of the magnet system and its screen to that needed to give full illumination to either selenium cell.

The degree dial is on top of the compass body and is read against a piece of cotton stretched over it fore and aft. Since the compass rotates when course is changed, precautions have to be taken that the five leads going to it (two for the lamp, three for the selenium cells) do not catch up. They are therefore brought out through a hole in the centre of the dial, which is bushed with polished hardwood and further led over a circular railing which keeps them clear of the various projections on the outside of the compass.

Compass Adjustment

There are no less than six permanent horseshoe magnets in the ship, apart from those in the compass. From stem to stern they are :—

(1) In the moving-coil milliammeter on the control panel (see Fig. 4). This is some 10 in. from the compass.

(2) In the compass course-changing motor situated beneath the control panel and 8 in. from the compass.

(3) A hefty one in the Weston relay, weight about 2 lb., situated amidships and some 22 in. from the compass.

(4) Steering motor aft and 42 in. from compass.

(5) and (6) Two small rudder magnets, also away aft (see Figs. 2 and 7).

It was scarcely surprising to find that with all this local disturbance compass errors were up to 80 deg., thus making the compass useless. Removal of each magnet in turn soon showed that the first three were the real offenders.

In theory, if the two poles of a magnet are arranged so as to be equidistant from a compass the mutual effect cancels out, and the compass sets itself in the earth's field. All three interfering magnets were found to produce fields very much stronger than that of the earth, even when sited as far away from the compass as the situation allowed. Hence it was clear that the only hope lay in orienting each of the three in turn so that their poles were as nearly as possible equidistant from the compass. It was found after much juggling that by suitably adjusting both orientation and tilt, their evil influence could be reduced to a maximum combined sin of some 25 deg. A series of readings all round the clock showed the resultant errors to be quadrantal in type, e.g., a maximum plus at, say, N, zero at E, a maximum minus at S and

* *Continued from page* 268, " *M.E.*," *March* 6, 1947.

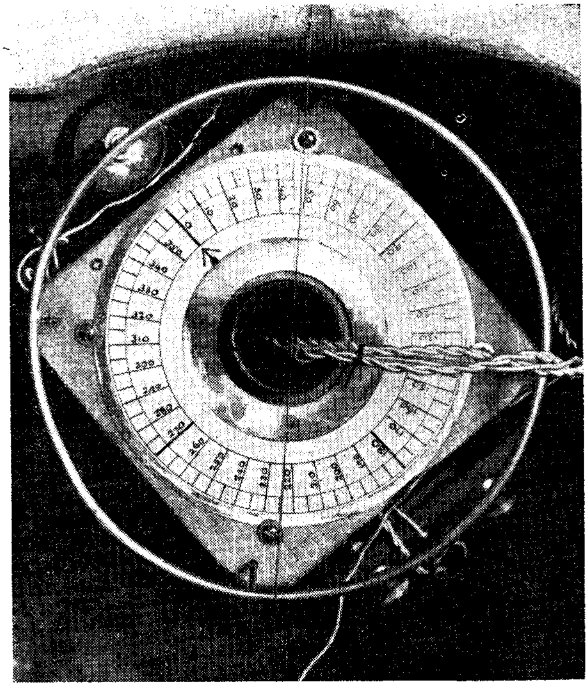


Fig. 5. Plan view of compass, set for course of 48°)

zero again at *W*. I still do not know why this should be, but suspecting it might have some connection with the possible dissimilar strength of the pair of bar magnets which form the compass magnet system it was argued that such a condition should be amenable to the correcting influence of another bar magnet. So it has proved, and the maximum error is now less than 8 deg. when the ship is placed on a turntable and swung to adjust compasses. In actual navigation, deviation seems rather larger, perhaps due to the uncorrected effects of the fields of some of the many electro magnets. This is not yet investigated, but the most important feature is that the deviation is reasonably constant for any particular course.

Rudder Stop

Not shown in Fig. 2, but marked X, in Fig. 7, is a stop which prevents the rudder armatures 10 getting out of effective reach of magnets 11. It allows about 20 deg. of free movement, which is sufficient to avoid damage to the rudder through bumps.

The three members forming the two ball-races, also the rudder and

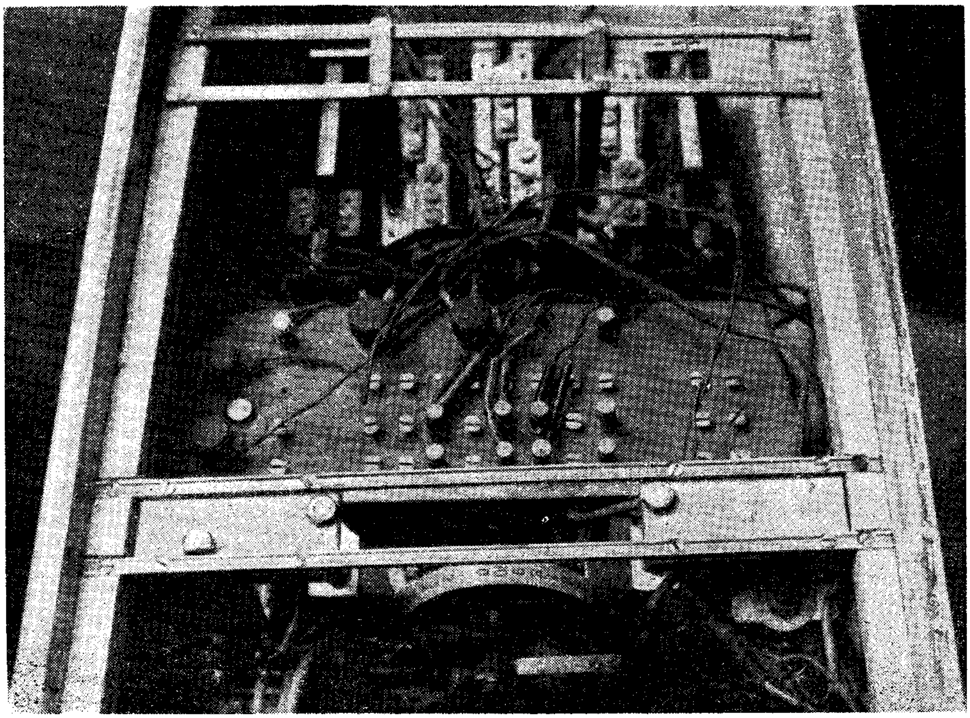


Fig. 6. Showing (bottom) the selector with terminal panel above and (top) five relays

stock, are made of Hiduminium alloy RR 56.

The rudder weight is all taken through the carrier, i.e. parts 2 and 4 in Fig. 2, by the stern frame.

Selenium Circuit

A 150-volt midget size H.T. battery is used. The operating current for the Western relay is up to 0.4 MA when either cell is fully lit, but the relay operates on 0.1 MA. The relation of angle of yaw with current through relay has not been plotted, but maximum sensitivity lies near the zero position, which is all to the good.

Motors

Main propulsion is a Nautilus motor with series field coupled to a 10 to 1 reduction gearbox. The course motor is *ex* a " Leeds " gauge " O " locomotive, a small pulley replacing the driving wheels. Further gear reduction is obtained by the spring belt drive to the compass worm pulley and again by the worm drive to the compass base. As a result the rate of change of course is about 90 deg. in 30 seconds. The steering motor is smaller again, being a " Mills " type designed for " OO " gauge locomotives. The total gear reduction between armature shaft and rudder is such that it takes ten revolutions to move the rudder 1 deg. A really low gear is desirable here for automatic steering. If the rudder (and hence ship) movement is too quick in relation to the damping of the magnet system in the compass due to its liquid filling, the yaw angle is artificially increased. This is because the compass is then relatively too slow in taking note of the change of direction and the ship " over-steers."

Current Consumption

Main propulsion motor, plus compass lamp, total 2 amps. This figure rises to 4 amps. when the other two motors are temporarily added. A 6-volt motor-cycle accumulator has ample capacity for the whole ship. With the propeller employed, the ship makes three knots when displacing approximately 50 lb., 10 watts or 0.013 s.h.p. being the power used by main engines.

Some Mistakes

On test the automatic steering jibbed completely when going astern. Routine tests revealed all to be in order, but nothing would make it perform properly afloat. It was really a very long time before it was realised that when going astern helm orders should be reversed also. What was happening was that instead of the compass moving the rudder so as to correct yaw, it was in fact increasing it, and the ship went round in circles. To put this right one more relay would be needed to transpose the main leads from the Weston when the selector is in position 8. Since, however, as the *Encyclopaedia Britannica* puts it, " When going astern, manoeuvring is

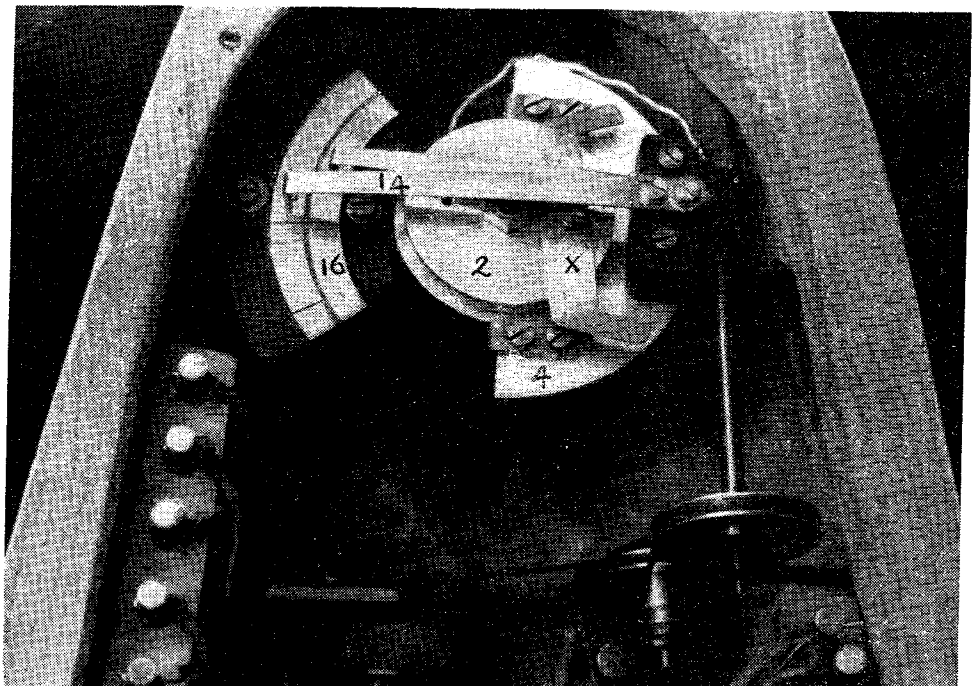


Fig. 7. (Bottom) steering motor coupled through double reduction rubber band drive to worm wheel shaft and (top) rudder carrier with rudder stop x and other parts bearing same numbers as in Fig. 2

performed with some uncertainty," this addition has not been made.

The hull, having a " cut-up " forefoot, turns very readily, and an Admiralty pattern stem with a straight edge down to keel level would be an improvement. This will probably be added.

There still remains the small radio receiver to make and install in the space reserved for it, also a certain amount of detail, but that is all well-worn ground. If required, it would be possible to install in place of the radio receiver a mechanism somewhat resembling the musical-box of our grandparents. Like this, it would have a drum with pegs in it, but instead of playing " Home, Sweet Home," or " The Last Rose of Summer," the pegs would key dummy radio pulses and the ship would go out carrying within her a whole series of future evolutions preselected to taste and bottled.

Such is the story to date. There is, however, plenty of scope for further development, and it may be for others to take up the tale, since my boys both tell me they expect the next off the stocks to be a submarine, and she should provide problems enough in controlling vertical steering without adding a compass.

Is this branch of small shipbuilding new ground? I expect not. Perhaps a " submariner " might oblige and say how it should be done. THE MODEL ENGINEER is read in most places and I am sure below the surface is no exception.

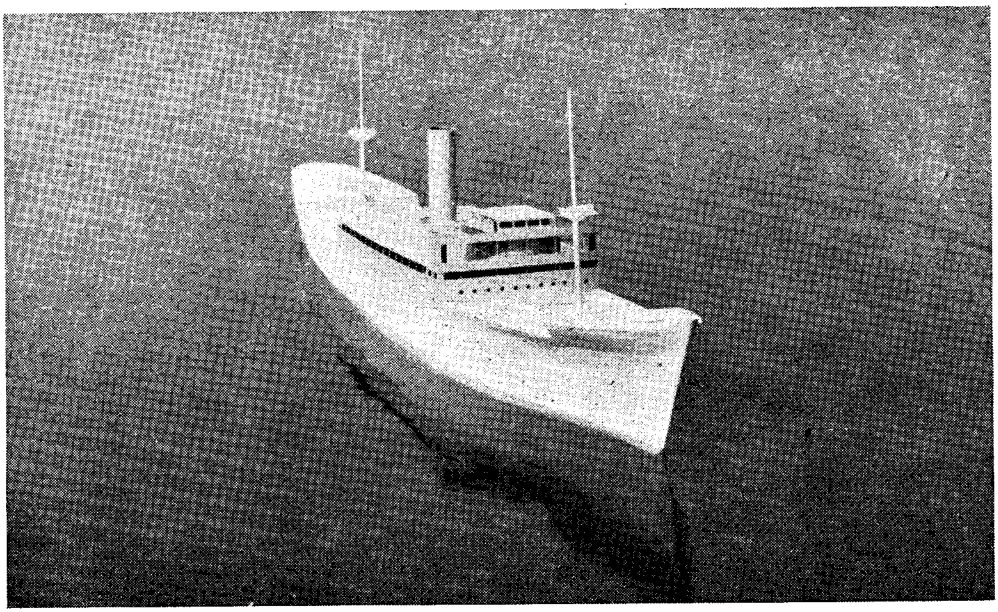


Fig. 8. " *Mark* II "

Radio-controlled Models Society

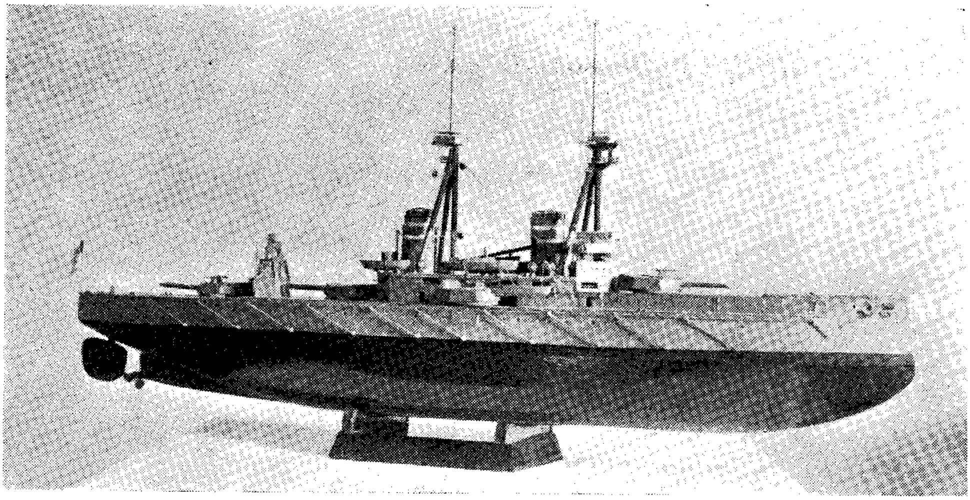
AT the meeting on Saturday, January 25th, Mr. R. Lawton relinquished the position of acting secretary on being unanimously elected chairman of the Society; Mr. J. C. Hogg was appointed secretary in his place. Further plans were made for the future, and it was decided that owing to the widespread interest shown, a country membership should exist for the purpose of those who are unable to attend the meetings in Manchester, but who wish to maintain contact and exchange information with other members, through the Society.

The acknowledgment of the Postmaster-General has been obtained, and it is hoped that the Society may become the governing body for experimental work in this field.

A guide for the use of members who wish to obtain components of various kinds connected with remote control is being prepared.

We are now anxious to increase our membership and make known the existence of the Society in as wide a field as possible.

Secretary: J. C. HOGG, 24, Springfield Road, Sale, Manchester.



A MODEL DREADNOUGHT

By H. W. MOFFAT

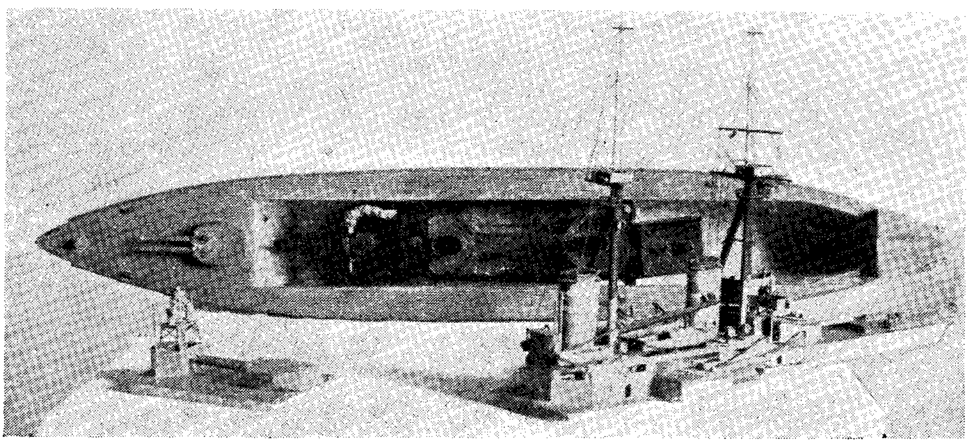
HERE are some photographs which may be of interest to readers of THE MODEL ENGINEER, especially those who served in the Navy during the first World War. The model portrayed represents the Dreadnought *Temeraire*, launched at Devonport, in 1907. Of 18,600 tons displacement, she had an armament of ten 12-in. and sixteen 4-in. guns, and a speed of 21 knots.

The model is to a scale of $\frac{1}{16}$ in. to the foot, which gives her a length of $32\frac{1}{2}$ in., although she is of more than scale draught. She was completed in 1943 by my brother and myself, most of our information coming from two postcards. The hull is carved from solid pine and the superstructure and removable deck are made of tinplate salved from food tins.

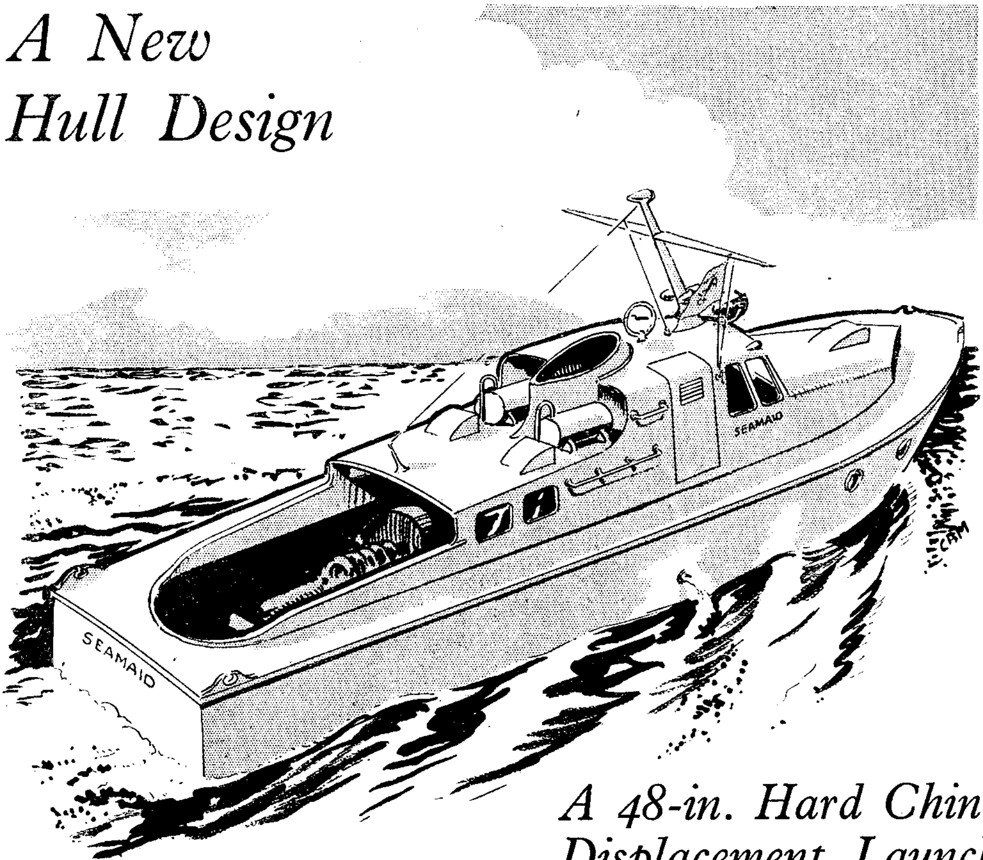
A typical period feature is the torpedo nets. The booms for these were made of 16-gauge copper wire, soldered to a round-headed screw at the lower end to represent the pivot, and to a headless screw at the upper end to hold them in place. The net itself is represented by a strip of bandage lashed up with thread and cemented in place on a balsa wood netshelf.

The plant is very simple. The boiler, spirit fired and silver-soldered, is a single 2-in. dia. drum, 7 in. long, with two $\frac{3}{8}$-in. dia. watertubes, and the engine, a Stuart Turner $\frac{7}{16}$ in. $\times$ $\frac{7}{16}$ in. oscillator, exhausts up the after funnel. The drive is taken through a spring coupling. The boiler gives plenty of steam and drives the ship at a fair speed, her bluff ram bow giving her a "good bone in her teeth." We have since discovered that the shape of the bow below the waterline is incorrect.

The underneath parts are painted red and I agree with your correspondent, Mr. Spackman, about the shine on models. Even the wrinkles in the cloth are reflected in this case.



A New Hull Design



A 48-in. Hard Chine Displacement Launch

IN view of the interest taken by model makers in the high speed power boats which were used for so many purposes during the war, we have prepared a set of drawings for a 48-in. hard chine displacement launch, giving full constructional details, which, together with the descriptive booklet which accompanies it, would enable anyone to build a model which would please the eye and also, when suitably powered, would give a very impressive performance in water. One or two power units are being designed for the boat, and particulars of these will be published in THE MODEL ENGINEER in due course.

The design is actually based on the popular 50-ft. hard chine cruisers produced by Vospers just before the war, which, with their speed of 30 knots plus, coupled with luxurious interior fittings, were a familiar feature of the big regattas. The model is approximately to a scale of 1 in. to 1 ft., which enables one to include a good amount of interesting detail. To simplify construction, hollow sections and planes have been avoided and, as in a model, these features do little or nothing to improve performance, such a liberty is quite justifiable.

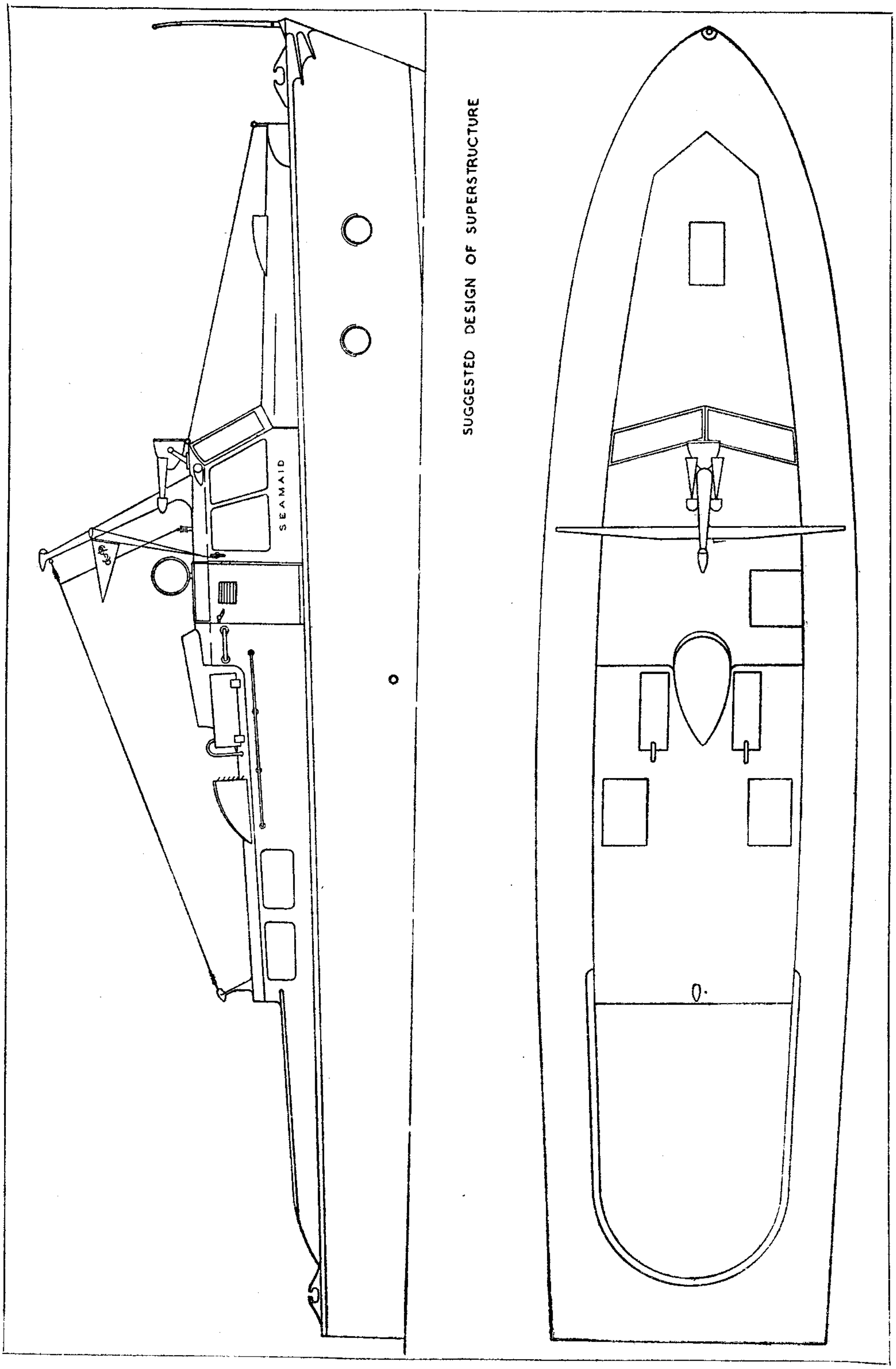
Owing to the difficulty of obtaining suitable material for building the hull by the usual methods, the frame and plank method has been adopted, the necessary strip and sheet hardwood being available at most aero model stockists.

As constructors usually have their own individual preference with regard to superstructure, we have contented ourselves with giving an outline of a suggested design which could be worked out in more or less detail or even entirely modified. A reduced reproduction of this is given on the opposite page. The hull proper is shown in four sheets of drawings, as follows :

Sheet 1. Hull arrangement—half-size.
,, 2. Aft sections and offsets—full-size.
,, 3. Forward sections and offsets—full-size.
,, 4. Profile and plan of superstructure—half-size.

The booklet accompanying the drawings describes the method of construction, and is suitably illustrated by detail sketches.

The complete set is now available at the price of 12s. 6d.



SUGGESTED DESIGN OF SUPERSTRUCTURE

* MILLING IN THE LATHE

By "NED" Section 7—Model Engineering Applications

A general review of the principles, appliances and methods employed for adapting the lathe for various types of milling operations

NUMEROUS examples have already been given of the kind of milling operations which are frequently encountered in model engineering, and how they may be carried out in the lathe by the various methods and appliances described. The purpose of this, the concluding section of the series, is mainly to give general advice to the reader as to the scope and possibilities of lathe milling processes, and how they may best be applied to the problems he encounters in the construction of particular types of models.

The order in which the methods and appliances have been described may be taken as indicating the order of their complexity, and also of the skill and experience required to employ them to the best advantage. If one attempts to use an elaborate milling attachment right away, with no experience of the simpler methods, it is as likely as not that an unfavourable impression will be obtained. In order to exploit any machine or process effectively, it is just as important to know what it will not do as what it will do.

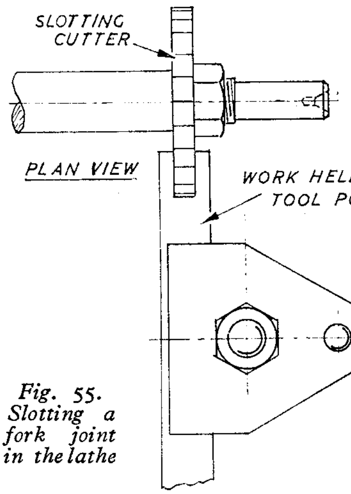


Fig. 55. Slotting a fork joint in the lathe

Many of the disappointments which have resulted from attempts to carry out milling in the lathe have been due to attempting too large a job, either in respect of its actual size, or in the extent of the cutting operation. It was pointed out at the beginning of this series that the lathe cannot be regarded as an efficient milling machine from the point of view of its ability to take heavy cuts and remove large amounts of metal. But even when the actual cut is light, the size of the workpiece itself often has an important influence on the success of the operation. A large casting or other structural part may not only be unwieldy, and completely dwarf the slide to which it is attached, but the distance of the surface to be operated on from the actual point of support may be excessive, so that undue leverage is exerted on the slides, and the liability to spring or chatter is much increased.

Wherever possible, large pieces should be bolted directly to the cross slide, with solid packing pieces and secure clamping devices, and operated on by a milling cutter in the lathe chuck. If, however, vertical adjustment becomes necessary, and a vertical slide must be used, the limitations of the method soon become apparent. To take a common example, attempts are often made to mill out the slots to take the hornblocks in locomotive frames in a small lathe, generally with indifferent results. The method usually employed is to bolt the pair of frames together and hold them horizontally in a machine vice

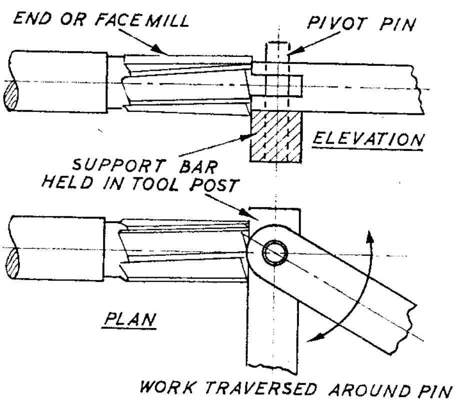


Fig. 56. Rounding the end of fork

attached to the vertical slide, using an end-mill in the lathe chuck to form the slot. In this case there is usually a considerable amount of spring in the work itself, apart from that of the slides, and the result is only too often bad chattering, snatching and digging in of the cutter.

An alternative method of dealing with this kind of operation is to clamp it longitudinally, in a horizontal position, over the cross slide, at approximately centre height, and use either a double side and face cutter, or a fly cutter, mounted in the centre of a long mandrel. This

* *Concluded from page 230, "M.E." February 13, 1947.*

method certainly provides much greater rigidity, but it calls for a lathe having a clear length of bed at least twice as long as the distance between the end slots of the frames, which is generally out of the question, so far as the equipment of the average model constructor is concerned. One may conclude, therefore, that this particular job is one that does not lend itself well to a milling process, and the more common and humbler method of filing out the slots will generally be found more satisfactory.

To jump to the conclusion that only a very large or heavy lathe is suitable for adaptation for milling, however, is quite erroneous, because even the lightest lathes have been applied with great success to milling operations within their capacity. Another fallacy which is often entertained is that milling in the lathe requires more power than normal lathe work. The fact is that an attempt to use the full power available on the average lathe would be more likely to strain the slides and bearings than to effect any useful purpose. A

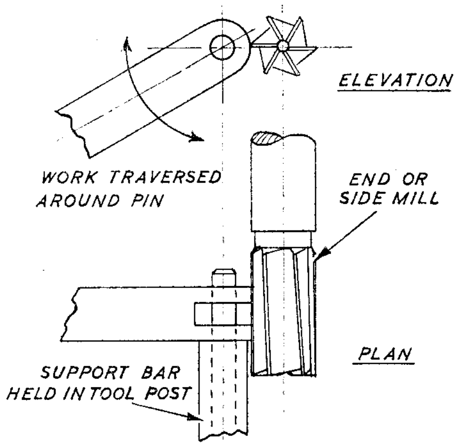


Fig. 57. An alternative method of rounding end of fork

fairly high torque at low speed is sometimes very useful in milling operations, just as it is in heavy turning operations, but so far as cutting rate is concerned, attempts to force the pace generally defeat their own purpose.

The beginner often fails to realise the side stress imposed in milling operations, and attempts to take too deep a cut or put on too heavy a feed. Overloading of cutters, with rapid dulling of the cutting edge, or breakage of teeth, is very common. Trouble is often caused by snatching of the cutter, due to insufficiently tight adjustment of slides, or feeding in the wrong direction.

Most model engineers will find that the small, "finicky" operations provide the best scope for milling in the lathe. Many jobs which would call for tedious and skilful hand filing or fitting can be carried out very quickly by milling, often with the simplest appliances, or practically none at all. For instance, a slotted fork joint on a link or connecting-rod can be milled out by clamping the work in the lathe tool-post, and using a slotting cutter or thick slitting saw (Fig. 55). The end of the fork may be rounded off neatly, and concentric with the pivot pin, by a simple milling process. A support bar, fitted with a vertical pin fitting the cross hole in the fork is mounted in the tool-post at such a height that the work is roughly symmetrical about centre level. By feeding the work up to a suitable end or face mill, and working the forked rod round the pin, a perfect semi-circle can be milled on the end (Fig. 56). An alternative arrangement consists of mounting the work on a horizontal pivot, and using a side mill (or an end mill with side teeth). This is more convenient for some classes of work, but needs firm control of the work to avoid snatching (Fig. 57).

Model steam engines of all kinds entail in their construction many operations which can be carried out by milling. Motion work, including rods, links, levers and crossheads, also slide-valve and joint faces on cylinders and steam chests, all offer scope in this direction. The cavity of a slide-valve can be produced more readily by milling than by any other process. Small boiler fittings, including check-valves, gauge-glass mountings, injectors, and feed pumps can offer many outlets for skill and initiative in the application of milling processes.

In the construction of historic types of engines, in which one of the most salient features is the beautiful detail work in the structural parts, it is often difficult to obtain small castings sufficiently accurate and clean to do adequate justice to the prototype. It is not only practicable, but often well worth while, to devise means of milling these parts. The constructor of a very remarkable set of beam pumping engines produced the fluted columns of the entablature by milling, and pedestals, brackets and panels, with geometric designs either in relief or intaglio, have also been machined by similar means.

Axle boxes for model locomotives are often milled on the sides to provide accurate sliding surfaces to work in the hornblocks. Saddle fittings for chimney, dome and safety-valve, which have to fit accurately on the rounded top of the boiler, may be milled to the exact radius required by means of an adjustable fly-cutter; the same method may be used in machining a cast smokebox saddle. The base of a traction engine cylinder presents a very similar machining problem, which can be disposed of in exactly the same way.

The milling of cams, which is necessary in constructing many kinds of machines, and model petrol engines in particular, has alredy been described. Pistons for these engines can be machined from the solid by simple milling processes, and in the smaller sizes of engines at least, are generally sounder and often lighter than those made from castings. The many toolmaking operations which the model engineer finds it necessary or desirable to undertake, may nearly always be facilitated or expedited by the judicious use of milling processes. Not the least useful of the capabilities in this direction is the ability of the cutter to "propagate its own species," or in other words, to produce more milling cutters when they are required in a hurry to deal with special jobs.

The many ingenious devices which have been developed by makers of ornamental turning

appliances, for cutting intricate geometrical forms, may not be directly applicable to the class of work under discussion, but their underlying principles are well worth studying if it is ever found necessary to tackle some milling operation of unusual complexity. It is also noteworthy that these appliances were used for working on all sorts of materials, including metals, wood, ivory, bone and even mineral substances such as marble and other stone. This is a reminder that milling can be usefully applied to the woodworking department of the model workshop, and is an extremely valuable aid in patternmaking or in making small "cabinet" parts for models. The woodworkers' tenoning machines, routers, chain mortisers, and spindle moulders are all specialised forms of milling machines.

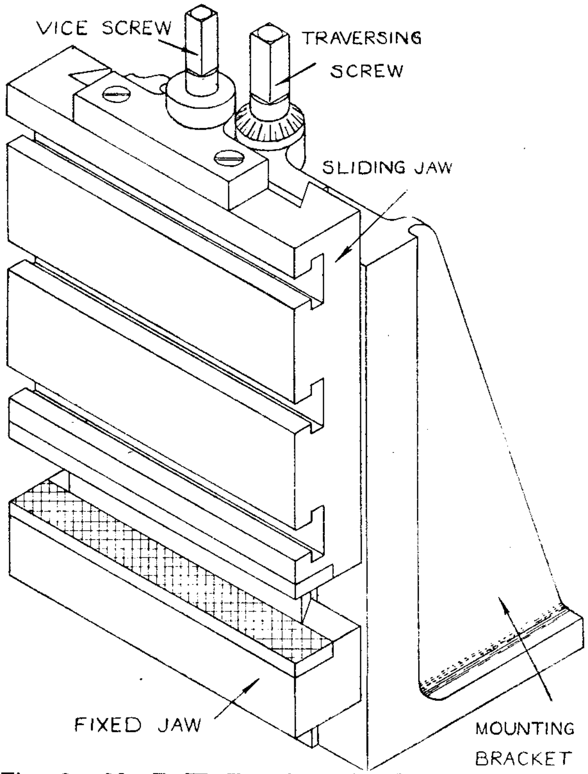


Fig. 58. Mr. E. W. Fraser's combined vertical slide and machine vice

Mr. E. W. Fraser, whose remarks on milling in the lathe, in the issue of THE MODEL ENGINEER dated September 26th last, should be taken to heart by all who tackle this class of work, has sent me particulars of a very useful vertical slide of his own design and construction, which is in regular use on his 5-in. I.X.L. lathe. This is of particularly sturdy and rigid design, and its special feature is the combination machine vice built into the sliding member. Mr. Fraser states that this fitting is practically a permanent attachment to the rear end of the lathe cross slide, and when not required for milling, it can be used to hold a rear parting or forming tool. As may be seen from Fig. 58, the slide is of the non-swivelling type, the traversing slideway being integral with the mounting bracket, which consists of a heavy angle plate with two bracing ribs or struts. The sliding member is fitted with a subsidiary slide, having tee slots in its front surface, and forming the moving jaw of a parallel vice. Both this and the stationary jaw on the lower end of main slide are equipped with hardened steel inserts.

Cutting Feeds and Speeds

A reader has suggested that some information should be given about milling feeds and speeds. It is beyond all question that these are most important matters, and indeed essential to success in all machine tool operations; but the idea so often entertained that complete data on this subject can be compiled in the form of a simple table, taking into account only materials, tool steels and surface speeds, is quite fallacious. The nature of the milling operation affects cutting speed very considerably, just as in lathe work, parting, forming and screwcutting operations nearly always demand a reduction of speed, compared to that used for ordinary turning. Similarly, it is often found necessary to reduce speed if the cutter has a tendency to chatter. A machine having a really rigid spindle and slides can safely be run at a much higher speed than one of lighter design, and this fact accounts very largely for the high speeds used in modern production milling.

For milling in small lathes, it will generally be found advisable to use substantially lower speeds, for a given type of work and cutter, than those usual in milling machine practice. Small end mills may be run at the top speed of the lathe, and fly-cutters, when used on brass or softer materials, generally work best at the higher speeds. But for larger cutters, speed should always be reduced, and for side and face mills working in steel and cast iron, it will generally be found best to use the back gear of the lathe, when cutters are used in the lathe mandrel, or a worm or spur gear reduction when a milling spindle is employed. Even in the production shop, experience is the only sound guide to the most efficient cutting speeds; and in the home workshop, where speed of production is of secondary importance, the golden rule is " When in doubt—reduce speed ! "

To conclude this series of articles, thanks are expressed to all readers who have contributed by furnishing hints and data, illustrations and opinions. No claim is made that the series exhausts the whole subject of milling in the lathe. But it is believed that typical examples have been given of all well-known and established types of appliances and their use, and sufficient detailed information on technique to assist the beginner to carry out simple operations, and to guide him past the worst snags and pitfalls.

"L.B.S.C."

LINK MOTION FOR "JULIET"

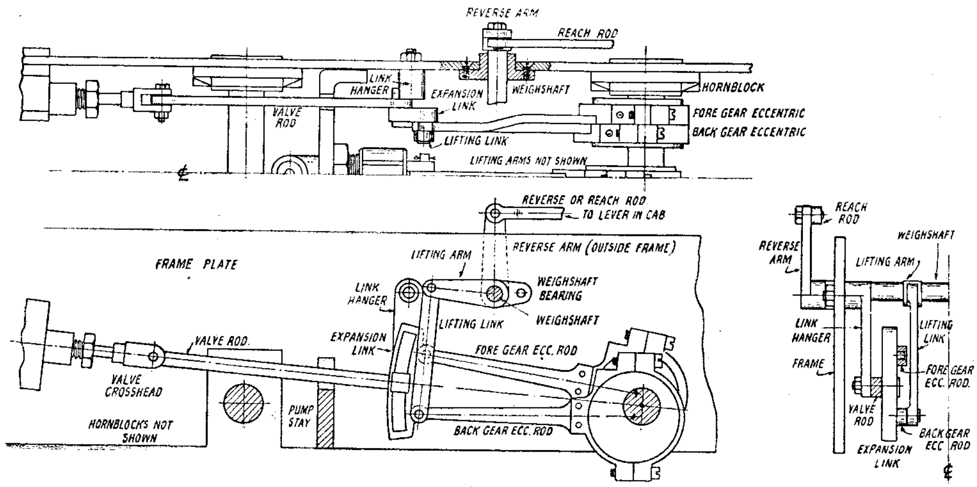
YOU will recollect that "Juliet" made her bow under the sub-title of "the simplest yet"; well, in the accompanying illustrations of a suitable link motion reversing gear for her, you will see that I have done my best to keep the whole bag of tricks down to the rock-bottom of simplicity, with due regard to efficiency. The Stephenson link motion—which, incidentally should, by the good rights, be called the Williams-and-Howe link motion, after the good folk who first thought of it—is quite a simple gear, despite the efforts of various people to surround it with an aura of mystery. Anybody who wishes to go fully into the "whys and wherefores," should borrow a copy of Colburn's *Locomotive Engineering* from their library, and read what Zerah of that ilk has to say about it; for practically all the journalistic efforts on the same subject that have since been written, are paraphrases of the notes by the clever old engineer mentioned. Another good dissertion on the link motion, is contained in Forney's *Catechism of the Locomotive*, and is much easier to digest than Colburn's. The above information may be useful to beginners.

As your humble servant takes an unholy delight in debunking and de-mystifying, there is mighty little to say about "Juliet's" link motion. The veriest Billy Muggins can grasp how the loose eccentric gear operates; in the present arrangement, we fix the eccentric on the axle, instead of leaving it loose, and set it O.K. for going ahead. We put another one beside it, instead of a stop collar, and set that merchant O.K. for backward motion. The ends of the eccentric-rods are connected to the ends of a slotted link; and in the slot of the link is a die-block, coupled to the valve rod which operates the slide-valve. By dropping the link to its lowest position, the die-block is brought opposite to the forward eccentric, and naturally follows its movement, imparting same to the valve, and so the engine goes ahead. By lifting the link, the die-block is brought opposite the backward eccentric, and the movements of the valve are reversed, so the engine goes backward. If the link is not raised or lowered to its full extent, and the die-block is not exactly opposite the end of the eccentric-rod, it is obvious that its movement will be less, thus restricting the movement of the valve, and cutting off steam earlier in the stroke. That, brother beginners, is an explanation of the Stephenson link motion in a nutshell; terribly complicated box of tricks, don't you think?

In order to keep "Juliet's" arrangement as simple as possible, all forked joints, with the exception of the ends of the lifting arms, have been dispensed with. The end of the valve rod is carried on a pin in a swinging lever called the link hanger; and as the die-block is mounted alongside it on the same pin, naturally they must work in unison. The ends of the eccentric-rods are not forked, but have plain eyes which work on pins fixed in the links; and same are lifted and lowered by lifting links attached to the lower pins, which are extended for this purpose. You couldn't have anything simpler, or easier to make and fit; and the proportions of eccentric-rods and links are exactly proportionate to those used on some of the latest Great Western engines, and what is good enough for Swindon, is good enough for "Juliet!" Now to construction.

Holes in Frame

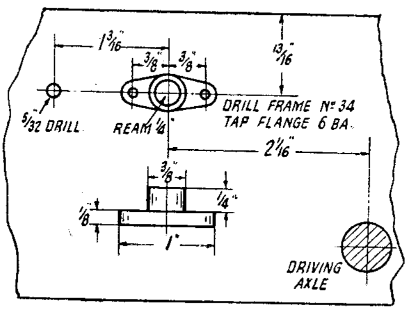
There are four holes needed in the frame, to



Simple link motion for "Juliet"

take the link hanger bolts and the weighbar shaft bearings; better drill these first. Note carefully: draw a line along the top of frame, between the wheels, $\frac{13}{16}$ in. from the upper edge; at $2\frac{1}{16}$ in. from the vertical line of the driving axle, make a centre-pop, and another $1\frac{3}{16}$ in. farther along. Drill the former $\frac{3}{8}$ in., and the latter 5/32 in. Tip for beginners: drill them all with No. 30 drill first, put a bit of straight $\frac{1}{8}$-in. wire through each pair, and you'll see, by the way the wire lies across the frames, if you have drilled them parallel. If not, correct with a rat-tail file before enlarging to correct sizes. On the same line, at $\frac{3}{8}$ in. each side of the $\frac{3}{8}$-in. holes, drill two No. 34 screw-holes, as shown; file off any burrs.

Make the weighbar shaft bearings and fit them, at the same time. Castings may be available; if not, chuck a bit of 1-in. brass rod, face, centre, and drill about $\frac{1}{2}$ in. depth with 15/64-in. or letter "C" drill. Turn down $\frac{1}{4}$ in. of outside to fit hole in frame, part off at $\frac{3}{8}$ in. from the end, reverse in chuck, poke a $\frac{1}{4}$-in. reamer through the hole, and skim off any burrs. File the flange oval, place in frame with flange inside, hold with



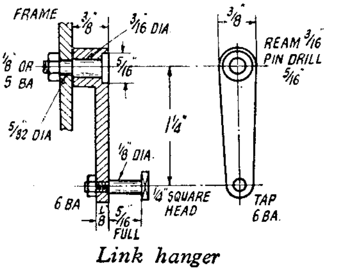
Weighbar bearing

toolmaker's cramp, run the No. 34 drill through holes in frame, making countersinks on the flange, follow with No. 44, tap 6-B.A., and put screws in; but don't fix "for keeps" until the weighshaft is erected.

Link Hangers

File up two pieces of $\frac{1}{8}$-in. by $\frac{3}{8}$-in. flat steel to shape shown, and drill two No. 44 holes at $1\frac{1}{4}$ in. centres. Chuck a piece of $\frac{3}{8}$-in. round steel rod, and turn a $\frac{1}{8}$-in. pip on the end, to a tight fit in the hole in larger end of hanger. Part off at $\frac{1}{4}$ in. from shoulder, drive the pip into the hanger, and braze or silver-solder it. Clean up, chuck the boss in three-jaw, face off any of the pip left sticking out from the face of the hanger, centre, drill with No. 14 drill, poke a $\frac{3}{16}$-in. reamer through, and pin-drill the hole with a $\frac{5}{16}$-in. pin-drill to a depth of $\frac{1}{16}$ in., like the leading boss of a coupling-rod. Tap the hole in the other end 6-B.A. For the fulcrum pin, chuck a bit of $\frac{5}{16}$-in. round steel rod in three-jaw, turn down $\frac{3}{8}$ in. length to $\frac{3}{16}$ in. diameter, a nice working fit in the hole in the link hanger boss. Put the hanger over it, boss outwards, and turn down the projecting bit to 5/32 in. diameter with a knife tool, until the tool almost touches the boss. This is an easy way of getting the working clearance without any measuring. Further reduce the end to $\frac{1}{8}$ in. diameter, leaving about 7/64 in. of the 5/32-in. portion; screw $\frac{1}{8}$ in. or 5-B.A., and part off the pin to leave a head $\frac{1}{16}$ in. wide.

The lower pin can be turned from a bit of $\frac{1}{4}$-in. square steel chucked truly in four-jaw. Turn down $\frac{9}{16}$ in. of it to $\frac{1}{8}$ in. diameter; further reduce a bare $\frac{1}{4}$ in. to 7/64 in. diameter, screw 6-B.A., and part off to leave a $\frac{1}{16}$ in. head. If



Link hanger

square stuff isn't available, use $\frac{3}{8}$-in. round, and file the head square.

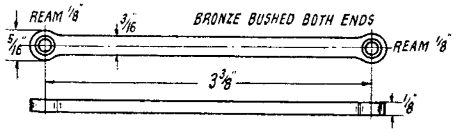
Valve-Rod

This is merely a sort of miniature coupling-rod filed or milled from $\frac{1}{8}$-in. by $\frac{5}{16}$ in. mild-steel, to the shape and sizes given in the illustration. Both ends are drilled $\frac{5}{16}$ in. and bushed with gunmetal or bronze, the bushes being reamed $\frac{1}{8}$ in. after being pressed in.

Eccentrics, Straps and Rods

The four eccentric-straps are made exactly as described for the loose-eccentric gear, so there is no need for useless repetition. The only differences in the sheaves are, that there are four of them, and in place of the stop pin, each one is drilled and tapped for a set-screw. Drill a No. 40 hole lengthwise through the widest part, as shown in the section, and open out to half its depth with No. 30 drill, tapping the remainder $\frac{1}{8}$ in. or 5-B.A.

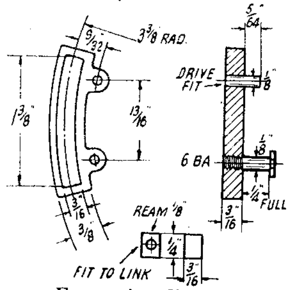
The rods are fitted to the straps in an exactly similar manner to that described for the loose eccentric-rods, but they are shorter; the ends are only $\frac{1}{4}$ in. diameter, so that they will clear the head of the die-pin. Two of them are



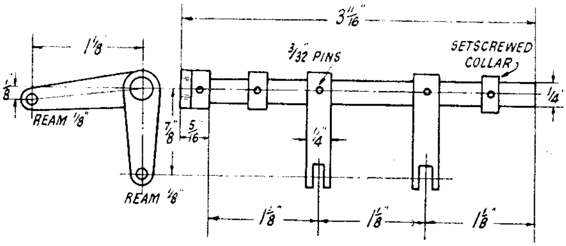
Valve-rod

straight, and two are set over $\frac{1}{8}$ in., as shown in plan of assembled gear, and also in the detail drawing. Particular attention of beginners is called to the requirement that all four eccentric-straps and rods *must be the same length between centres of straps and eyes*; and for their especial benefit I will briefly repeat how to make a simple jig for ensuring this. Get a piece of flat bar, say about $\frac{3}{16}$ in. by $\frac{3}{4}$ in., or larger section, and about 4 in. long. Scribe a line down the middle, and on it make two centre-pops 2 31/32 in. apart. Drill these out with a No. 32 drill, either

on drilling-machine or lathe; *not* by hand, as it is important that they go through dead square. In one of the holes squeeze a short bit of ⅛-in. silver-steel; in the other, a dummy eccentric. Chuck a piece of 1¼-in. steel rod, and turn down about ½ in. of it until one of the eccentric straps fits over it exactly without any shake; then turn a ⅛-in. pip on the end about ⅛ in. long, the pip being an exact fit for the hole in the bar. Part off to leave about 5/16 in. of the 1⅛ in. diameter beyond the shoulder, and slightly round off the sharp edge; then press the pip into the bar. You now have a jig consisting of a bar with a pin and a dummy eccentric at exactly the right centres for the finished strap and rod. To use it, put the strap over the dummy eccentric with the rebate in the lug upwards; put the eye of the rod over the ⅛-in. pin, and lay the other end in the rebate in the lug. Solder it in position, with the two parts still on the jig; then remove it and put the rivets through the lug and the end of the rod. The offset rods are bent before putting them on the jig, and a ⅛-in. washer placed over the pin, to line them up correctly with the eccentric-straps. If all four eccentric-straps and rods are assembled on the jig as described, it is impossible for them to be anything else but all alike. The eyes can be case-hardened instead of bushed, as drilling big holes for bushes would weaken them unduly; but before case-hardening, slightly countersink the eyes in the two offset rods, on the outside of the bend. Beginners again note: to case-harden, simply heat the eyes to bright red, dip in any good case-hardening powder (Kasenit, Ecosite or similar) reheat until the yellow flame dies away, and quench out in clean cold water. Be sure to fill up the eyes when dipping; after quenching, clean any residue off, and polish up with fine emery-cloth. Lastly, don't forget you want two right-hand and two left-hand rods, one bent and one straight of each kind; so bear that in mind when milling or filing the rebates in the lugs on the straps. Keep the plan view of the assembled motion in front of you when marking-out the lugs, and there won't be much chance of going astray.



Expansion link



Weighbar shaft

Expansion-Links

Not much chance of going astray here, either, if ordinary care is used. Mark the outline of the links on a piece of 3/16-in. ground flat stock, the fine grade of cast steel used for gauge and tool making; if you can't get any, use ordinary mild-steel. Cut the slots first; drill a few holes down the marked centre-line, run them into one with a rat-tail file, then open out with a half-round or fishback until a piece of 3/16-in. silver-steel can be slid easily, without shake, from top to bottom. A small square file will finish off the ends of the slots. When you get them O.K., saw and file the outline of the links around them; sounds something like building a barrel around a bunghole, but it is the best way I know, of making links by hand. It isn't worth the trouble of rigging up a special arrangement for milling the slots, when there are only two links to make. A piece of ⅛-in. silver-steel is squeezed into a No. 32 hole in the upper lug; the lower one is drilled No. 44 and tapped 6-B.A., to accommodate a screw which is turned from ¼-in. hexagon steel, to the dimensions given, by the same process used for the hanger screw. The die-blocks are filed up from odd bits of the 3/16-in. steel, and should slide from top to bottom of the slots easily, without any shake. Drill them No. 32 and ream ⅛ in. If made from gauge steel, harden the links and die-blocks right out. If mild steel, case-harden, as mentioned above. As the pin in the upper lug has to be riveted slightly into the eccentric-rod eye when assembling, it must be softened, and this can be done by holding a red-hot poker against it for a few seconds or so.

Weighbar-Shaft and Lifting-Links

The shaft is a piece of ¼-in. bright round mild- or silver-steel, 3 11/16 in. long. The two lifting arms are filed or milled up from ⅜-in. by ¼-in. mild-steel, to the shape shown; one end is drilled ¼ in. drive fit, and the other end reamed ⅛ in. This end is also slotted ⅛ in. wide and 5/16 in. deep; the piece can be held in the slide-rest tool-holder, and fed up to a ⅛-in. slotting cutter on a spindle held in chuck or run between centres, or it may be done on a planer or shaper, or by hand filing as preferred. Drive the two arms on the shaft, as shown, so that their centre lines are 1⅛ in. apart, and 1⅛ in. from one end; make certain that they are quite parallel, which can be done by putting a piece of ⅛-in. straight silver-steel through both forked ends at once, and then pin them to the shaft by drilling No. 43 holes through the lot, and squeezing in bits of 3/32-in. silver-steel or 13-gauge spoke-wire. Turn up two little collars 3/16 in. wide, drilled an easy sliding fit on the shaft, and fit them with set-screws. The reverse arm is made exactly as described for the link hangers, but to the dimensions given in the detail drawing; the

boss is drilled ¼ in. drive fit, and the small end reamed ⅛ in. Don't fix it to the shaft yet.

The two lifting-links are simply pieces of ⅛-in. by ¼-in. flat steel rod, drilled No. 32 at 1¾-in. centres and reamed ⅛ in.; the ends are rounded off, and one side is relieved to the depth of 1/32 in., to avoid rubbing on the eye of the forward gear eccentric-rod, see end view of assembled motion.

How to Erect the Gear

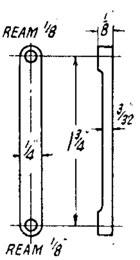
Put the eye of the fore-gear eccentric-rod over the pin in the upper lug of the expansion-link, and rivet over the end just enough to prevent the eye coming off, but not enough to prevent free movement of the eye on the pin. There should be only the merest fraction of end play. File the pin flush with the eye. Attach a lifting link, and the back-gear eccentric-rod, to the bottom lug of the link by the hexagon-headed bolt made specially for the job as above. When screwed right home, eye and end of lifting-link should both be free, but with only the slight end-play mentioned. Give the projecting end of the screw a gentle tap or two, so that there will be no chance of it slacking off when "Juliet" gathers up her skirt and runs. Next, put a die-block on the square-headed pin which fits in the bottom of the link hanger; poke it through the expansion-link, fitting the die-block in the slot of same. Put on one end of the valve-rod, screw the pin through the link hanger, taking care that the head will be parallel to the link slot when erected, and put on a nut at the back to lock it. Put the fulcrum-pin in the top of the hanger, set the whole bag of tricks between the frames, poke the fulcrum-pin through the 5/32-in. hole in frame, and put the nut on. The eccentric-straps can then be placed on the sheaves, and the screws put in; the other end of the valve-rod is placed between the jaws of the valve fork or crosshead, and the bolt put through.

Put the two collars on the weigh-shaft, close to the lifting-arms, and then the two bearings, flanges inward. Put the longer end through one of the ⅜-in. holes in the frame; doesn't matter which, you can have the engine right or left-hand drive as preferred. G.W.R. are right, the others left; the Brighton engines were "driver-on-the-left," I prefer that side, as it was better for most of the platforms and signals. Set the shaft horizontally, and run it back until the short end enters the other hole; then run the two bearings up to the frame, enter the bosses in the ⅜-in. holes, and screw the flanges to the frame, as shown in the plan view. Set the shaft so that the two lifting-arms are central, then run the little collars back against the bearing flanges and tighten the set-screws; or you can pin the collars to the shaft if you so desire. Put the upper ends of the lifting-links in the slots of the lifting-arms, and secure with bolts made from pieces of ⅛-in. silver-steel shouldered down at each end and nutted, as described previously. Put the reverse arm, boss inwards, on the projecting end of the weighbar-shaft; set it so that it is vertical when the die-blocks are in the middle of the links, pin it to the shaft, same way as the lifting-arms, and Bob's your uncle.

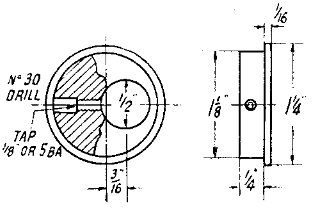
How to Set the Valves

If you want "Juliet" to Pull and Go, in the manner usually observed among real "Live Steamers," set your valves like this: Take the steam chest covers off; push the reverse-arm forward, so that the die-blocks are opposite the fore-gear eccentric-rods, and turn the wheels by hand. Adjust valve on spindle so that the port openings at both ends of the movement, are equal. Now put the crank on front dead centre, and adjust the eccentric so that the port is just "cracking," showing as a visible black line at the edge of the valve. Tighten the set-screw and go around to back dead centre. If you get the same crack, the setting is O.K. If no crack shows, the valve is too long; take a shade off *both ends* and try again. Then pull the reverse-arm back, so that the die-block is opposite the back gear eccentric rod, and adjust the eccentric same as before, so that you get the crack on both front and back dead centres of the crank. When you get a crack on each dead centre, both in forward and back gear, the setting is O.K. The amount of lead increases as a link motion is notched up; and believe me or not, just as you like, you need plenty when a little-wheeled engine travels at high speed, and the coupling-rods fade out of the picture, otherwise you lose power. Any unprejudiced person can easily see that to get full pressure on the piston heads as the crank passes dead centre, you have to open the ports BEFORE the crank gets to dead centre; and that is one reason why Curly's engines do the doings in the manner once deemed "impossible." The faster the engine goes, the sooner the ports should open, just the

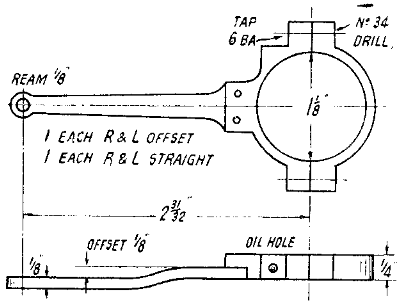
(*Continued on page* 309)



Lifting link



Eccentric



Eccentric strap and rod

LOCOMOTIVES WORTH MODELLING

By F. C. Hambleton

No. 21—Midland Railway No. 1853

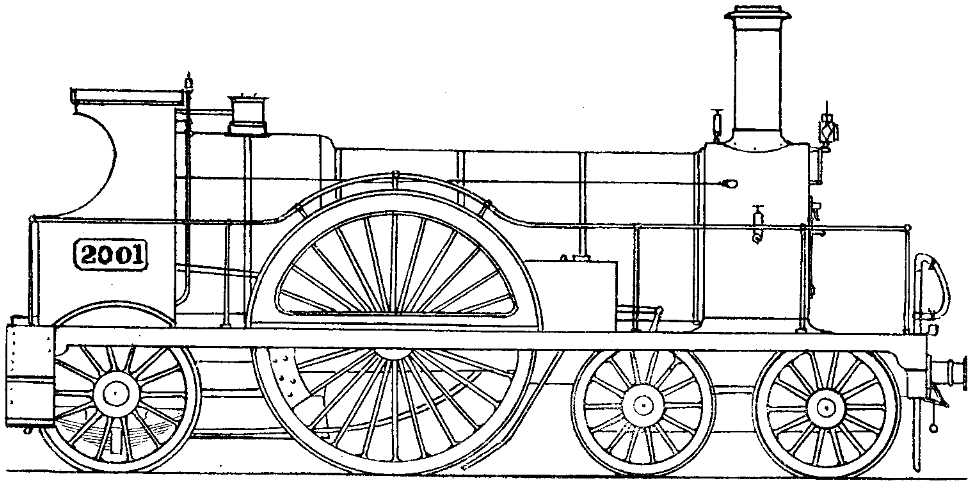
THE engine that carried off the senior award—the Grand Prix—at the Paris Exhibition of 1899 was the Johnson 7 ft. 6 in. single-wheeler, No. 1853, and a short description of her will complete my account of the three splendid English locomotives sent across the Channel for the great international event. With her superb finish and workmanship, and coupled to a wonderful 12-wheeled M.R. coach, she entirely won the hearts of all beholders. She was linked up, too, with the L.B.S.C.R. exhibit, *Edward Blount*, in a number of interesting ways. To begin with, both designers had been associated in days past on the old Edinburgh & Glasgow Railway, when in 1864-65, Stroudley had been works manager to Samuel Johnson at Cowlairs,

Stroudley and Billinton

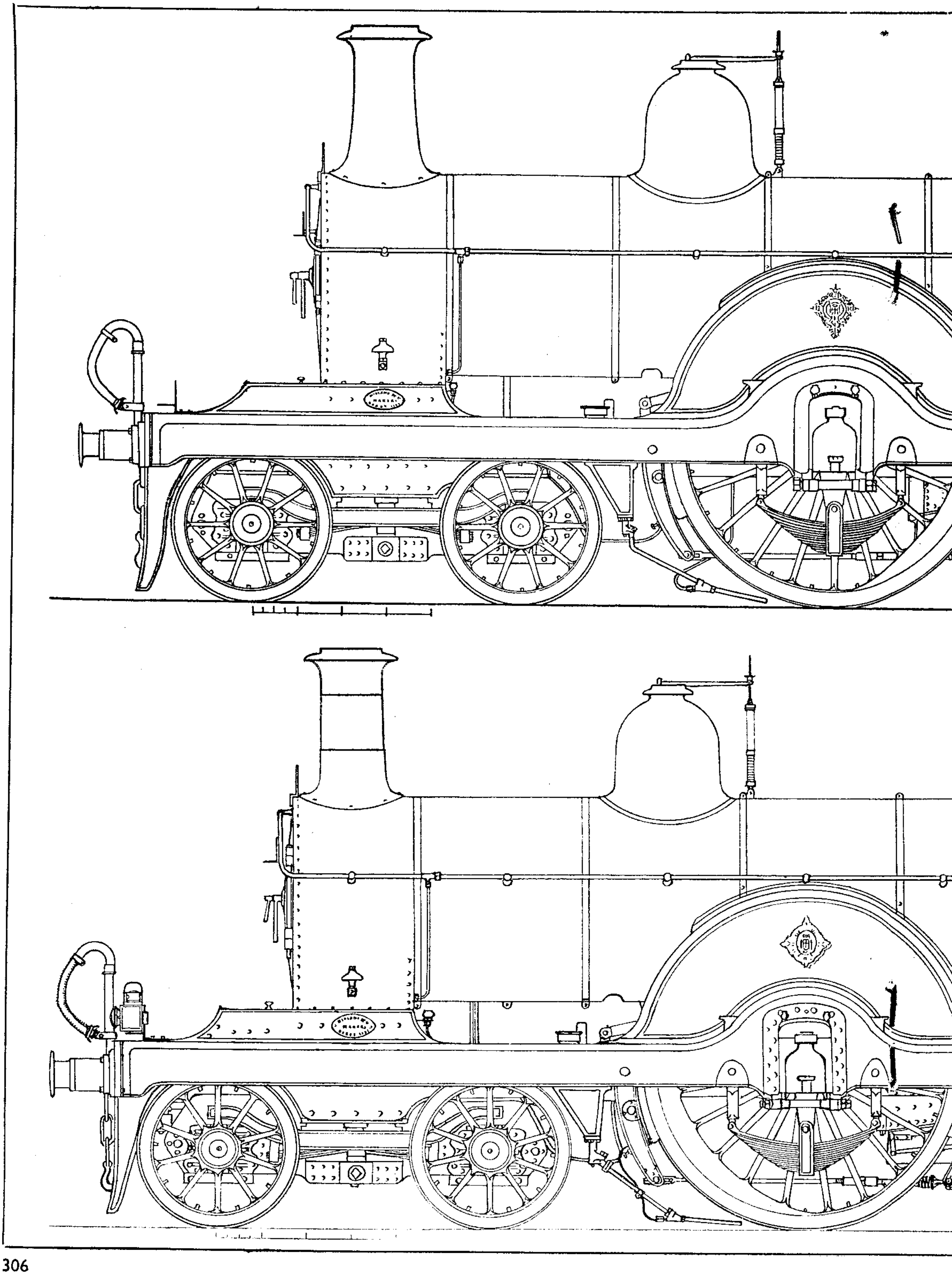
Again, in 1874, Stroudley's draughtsman, Robert Billinton, had left Brighton, after seeing the completion of the grand 6 ft. 9 in. *Grosvenor*, to serve under Johnson at Derby, rising to position of chief draughtsman there. When Billinton again went south to succeed his former chief, Stroudley, his own engines bore the characteristics of both the famous engineers. There had been but few inside-cylindered engines of the 4-2-2 type before the advent of M.R. No. 1853. The first ones had been rebuilds of old Bristol & Exeter tank engines. These were the No. 2001 broad-gauge G.W.R. class, eight-footers with 18 by 24 in. cylinders, that took their share of the express work with the famous Gooch singles, although not so highly regarded by the men as the latter. They appeared in 1877. Eight years later Beyer Peacock built some 4-2-2's for the Irish G.N.R., and then in 1886, Neilsons designed and built the wonderful Caledonian Railway No. 123. The astounding performances of this seven-footer, aided, no doubt, by the newly-invented steam sanding gear of a Derby engineer, Mr. F. Holt, may well have influenced Johnson to settle on this type of engine for Midland express work. He had already had some experience of such a design himself—but of the outside-cylinder variety—when, in 1872, he had converted two G.E.R. Sinclair 2-2-2's, Nos. 51 and 291, by substituting an Adam's bogie for the leading pair of wheels. In their altered form they resembled somewhat a smaller edition of Stirling's G.N.R. No. 1. With their Johnson boiler fittings, and painted Stroudley yellow, these two engines were a remarkable fusion of G.E.R., G.N.R. and L.B.S.C.R. ideas!

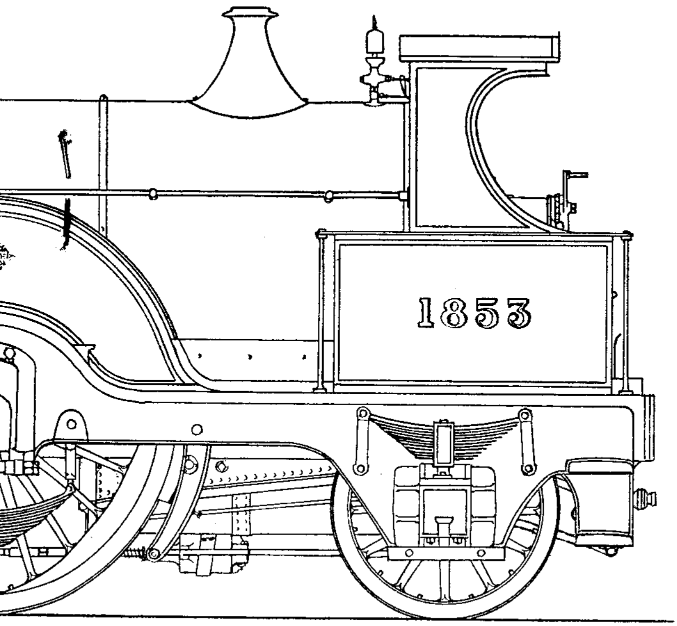
The Exhibition Engine

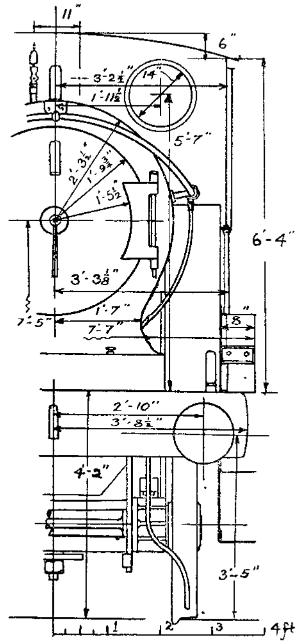
Hence it came about that Caledonian No. 123 was followed in the next year—June, 1887—by the first M.R. 4-2-2's, Nos. 25-32. These had 7 ft. 4 in. driving wheels, and then in 1888 came the exhibition engine, 1853, with slightly larger 7 ft. 6in. wheels, and 18½ by 26 cylinders. She was every inch a "Midlander," but displayed one novel feature, an entirely new design of smokebox. In this the tubeplate was circular, and was let into the boiler barrel itself, which in turn rested on a steel saddle-plate bolted to the cylinders. It was so placed as to render all the tubeplate rivets accessible without lifting the barrel from the saddle. A circular flanged tube-plate had been used in the *Edward Blount* design, and no doubt Billinton, who had much to

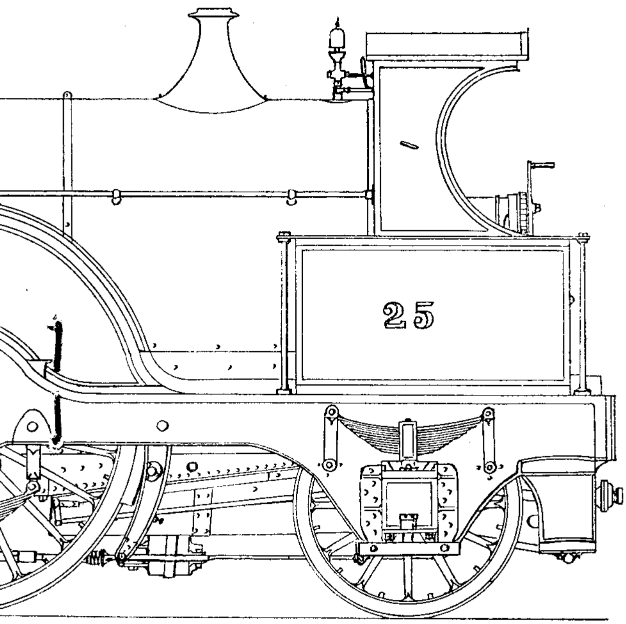


A sketch of the first 4-2-2 inside cylinder locomotive. With eight-foot wheels these G.W.R. rebuilds took a big share in the express work of 1872







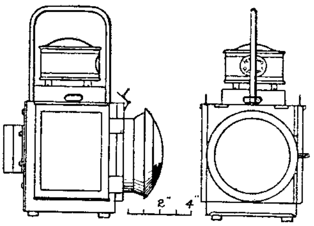


Above, left: The Exhibition engine had much the same dimensions as No. 25, but cylinders and the 7 ft. 6 in. driving wheels were larger. Later on, rear sandboxes were fitted

Above, right: Standard M.R. smokebox, cab and buffer beam are features of the front elevation of No. 1853

Left: The first of the Johnson singles. Nos. 25-32, 37 and 1854-62 were the 18 of the 7 ft. 4 in. class built in 1887-89

do with the planning of the M.R. singles, was mindful of its success at Brighton. The result, in outward appearance, was that both 1853 and 189 had smokeboxes flush with the boiler cleading plates, giving a very neat effect. Internally, the two smokeboxes differed a little, for Johnson employed a double-walled one, lagged, together with the barrel, with silicate of cotton. A novel



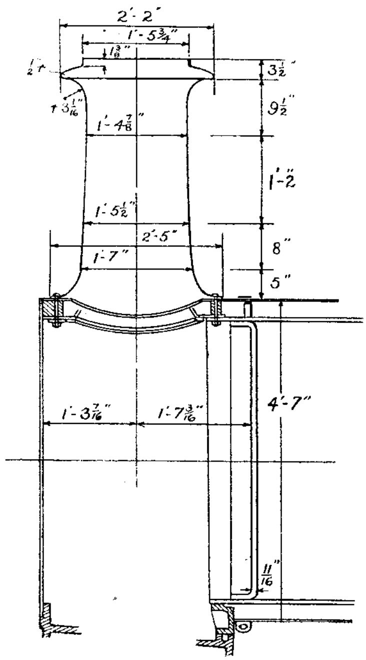
The Midland lamps were engine-red with black edging and fine yellow line. Note the brass lens ring and polished handle

smokebox seems to have suggested a novel chimney, and just as in the case of Stirling at Doncaster, the built-up pattern was replaced by a smooth casting, yet still bearing the old familiar Johnson outline. Both designer and chief draughtsman must have thought the effect "Mighty fine, mighty fine," for it became henceforth the M.R. standard, and Billinton also took it (together with the smokebox design) to Brighton with him, slightly refining the profile of the top cover plate secured to lugs inside the bell-top of the chimney barrel. Another point of resemblance between 1853 and 189 was the spring-balance safety valves on the dome, although they differed also in internal arrangements. The Midland valves were of the usual mushroom type, $3\frac{7}{16}$ in. diameter, controlled by a long 1 ft. $10\frac{3}{8}$ in. lever, painted dark red, by the way, and not polished like Stroudley's. They were set to blow off at 160 lb.

Fizzing Valves

The Johnson boilers were wonderfully free steamers, and to give them an extra chance of getting rid of their surprising exuberance a direct loaded valve, set at 162 lb., was mounted on a flat man-hole plate, the whole covered by a glorious little brass casing held down fore and aft by neat hexagonal nuts. It was no unusual sight to see all three valves merrily fizzing away at the same time! Again, when Billinton designed his magnificent 4-4-0 L.B.S.C. *Siemens*, but without spring-balances on the dome, he bethought him of his years at Derby, and gave his lovely new engine direct-loaded valves on the firebox. Unlike C.R. No. 123, the Johnson engine had sandboxes below the footplate. Here they could also act as frame-stays, and they carried a lug which formed a bracket for the brake hanger. In their absence above-board, a splendid view of the motion could be obtained. The Stephenson gear was a typical example of British practice, fitted with good-sized pins, $1\frac{3}{4}$ in. diameter. The cranks were hooped, and both crank-pins were drilled to take $2\frac{1}{2}$-in. bolts with an hexagonal head at one end, and on the inner, or eccentric side, well riveted over. After the crankshaft was finished the eccentrics were cast on to it, four slots being first machined into the shaft for the metal to fill and grip on. The eccentric-straps were of cast iron, thereby rendering them of the "fit and forget" variety! The engine was reversed by a screw of the Stroudley pattern, but fitted with a double handle instead of a wheel. Such a pattern was later to be found at Brighton, and on the G.W.R. Dean *Lord of the Isles* class, and elsewhere. No. 1853 had a novel ashpan made out of a single sheet flanged into box form, and provided with a front damper only. The smokebox was kept shallow and the blastpipe orifice placed low. It was as large as $5\frac{7}{16}$ in. in diameter, but with a petticoat pipe and chimney liner it was found that an excellent equalisation of draught was obtained and, needless to say, back-pressure on the pistons was largely reduced.

The general equipment included the following items: a couple of Furness lubricators. They were handsome polished chaps with a very Midland-chimneyish outline, and only fed to the cylinders when steam was shut off. A sight-feed lubricator in the cab delivered oil at about two drops per minute through a feed pipe run through the handrail on the fireman's (L.H.) side.



Standard M.R. chimney casting and double smokebox with circular tube-plate

The rail was lagged to prevent it becoming too hot to the hands. Simple metallic packing was fitted to the piston rods. A steam brake, with a cylinder below the ashpan, and another one on the tender, was actuated simultaneously by the train vacuum brake handle, the large ejector was

placed close to the smokebox on the right-hand side, whilst the small ejector also functioned as a blower. The larger brass whistle was a good-looking affair with a bell, $4\frac{3}{4}$ by $3\frac{3}{8}$ in. diameter (still largely in use on the L.M.S., by the way) and its companion was a tiny little fellow, only $3\frac{1}{4}$ by $1\frac{1}{2}$ in., but which squealed right lustily when anyone in distress pulled the communication cord! Two Gresham injectors on the firebox front were very accessible, as were the two convenient toolboxes. The regulator handle was a long 18-in. one, elegant in shape, and the firedoor was given louvres, so angled that when shut not a trace of glare was present, and when opened only a slight reflection from the fire was thrown downwards on to the floor.

Glitter work

There was a fair amount of glitter-work about the engine, for in addition to the two whistles, the casings of the safety valve springs and the rims of the 14-in. cab windows, there were the $6\frac{1}{2}$-in. brass numerals (perhaps the tallest in use at that period), the 2-in. polished rim round the big splasher, the truly wonderful driving wheel axlebox with its four attendant lubricators, together with the polished brass handles and lens-rims of the headlamps, and the polished steel top plates of the two rear, and six tender, axleboxes!

It is difficult to give an adequate impression of the degree of finish of the exhibition engine. But this is how it was obtained, and after reading the account of what happened in the Derby beauty-parlour, perhaps a dim idea of her mirror-like surfaces may come to the mind. Here goes. First a coat of priming before steam trials. These over, all rust and scale was removed and two coats of lead-coloured paint were applied. After thoroughly drying, all defective surfaces were stopped or filled up with a mixture of gold size and dry white lead. These were then rubbed down with pumice and water to a perfectly smooth finish. Next came no fewer than four coats of purple or chocolate, and lastly one of a mixture of crimson lake and purple brown to give the famous Midland dark red tint. Lining with black edging and its thin yellow stripe followed, and the black work of platforms, brake gear, etc., was finished. And now, patiently, one after the other, came five coats of best varnish! No wonder it took six days to get over all this! The engine proudly left the paint shop in all its glory, though personally, I always thought that six months' wear was needed before perfection was obtained. In that time all steel handles and brass work got that lovely glow that comes from repeated friction from men's hands, or from rag and metal polish. The lining scheme was simple—just a small black border with an inner single fine yellow line next the red.

This was placed on cab side-sheets and front sheet, round the windows, at the base of dome, lagging belts, driving splasher, round edge of red mainframe standing above footplate under the smokebox, along outside frames and steps, round the red guardirons, round the red sandboxes, driving horns, and round the other eight axleboxes. Tyres black with one yellow line, bogie hubs red with two yellow circles, and little vees top and bottom of spokes.

The buffer beam and buffer sockets were vermilion, edged black, with fine white line (the buffer sockets having this edging at the outer end only). Gilt letters with blue shading adorned the buffer beam and tender side. The latter had two black rectangular bands with a yellow stripe on either side, and its red coping was also lined with a yellow stripe. The outside springs of the engine were dark red with a yellow stripe along the top and bottom leaf. The interior of the cab was light grain edged with a broad black band separated from the grain by a fine white line. In addition to these three wonderful exhibition engines, Nos. 1853, 189 and 240, the L.N.W.R. sent a fine model of one of their compounds, *Dreadnought*; whilst the North London Railway contributed a superb $\frac{1}{8}$-scale model of one of their 4-4-0 tank engines. Yes, there were models as well as the "real thing" to delight the eyes of the visitors to that truly wonderful exhibition of 1889!

Useful Dimensions

Length of buffers 1 ft. $5\frac{1}{2}$ in. Leading overhang 2 ft. 3 in.

Bogie wheelbase 6 ft. 0 in. Bogie to driving axle 7 ft. $0\frac{1}{2}$ in. Driving axle to trailing axle 8 ft. 9 in. Trailing overhang 3 ft. 8 in.

Diameter of wheels 3 ft. 6 in., 7 ft. 6 in., and 4 ft. $2\frac{1}{2}$ in.

Boiler 4 ft. 7 in. (lagging) by 10 ft. 4 in. Firebox 6 ft. 6 in. long. Driving axle to firebox front 1 ft. 9 in.

Link Motion for "Juliet"

(*Continued from page* 304)

same as advancing the ignition in the cylinders of an automobile "exceeding the limit."

Valves can also be set under pressure, by disconnecting the big or little end of the connecting-rod, applying air pressure to the steam-chests by a tyre-pump, and turning the wheels by hand. The piston-rods should shoot in and out vigorously, at the exact instant the cranks reach the front and back dead centres. I usually set my own engines' valves under pressure, as I find it saves time, especially in the case of piston-valves. Well, so much for that; all we now need is a reversing-lever for the driver, and that will be the next item.

CUTTING-OIL for a Small Lathe

By J. Corbett

ALTHOUGH several methods of dispensing lubricant on small machine-tools have previously appeared in THE MODEL ENGINEER, it is thought that the following much-simplified method might appeal to those who, like myself, have only a small amount of space available, and wish to cater for a small lathe only, or one or two small machines.

Anyone who has ever had access to a machine fitted with a "flooded system" will appreciate that this is an invaluable addition to a small lathe, and it has been found invaluable when parting-off, obtaining a fine finish and particularly for boring, drilling and milling operations.

The lathe to which the following system was fitted is the well-known 3½-in. M-type Myford, and advantage was taken of the self-contained motor-mounting and countershaft to form the fixing for the pump, which is extremely simple, and the drive, although the arrangement could be easily adapted to any machine.

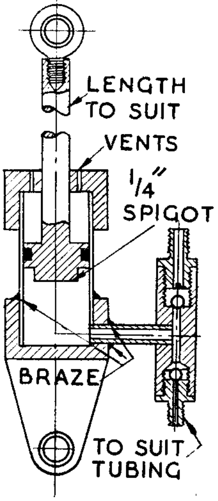


Fig. 1

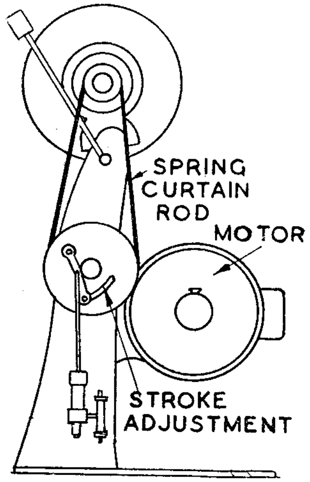


Fig. 2

The Pump

This is similar in every way to our good friend "L.B.S.C.'s" 2-hour pump, though slightly larger, and the valves are so arranged to permit the pump to function when mounted upright, by attaching the valve-box in the same plane as the cylinder. The pump used on the system described is of ½-in. bore × ¾-in. stroke, although ½-in. stroke has been found ample under most conditions, and provision has been made to enable the stroke to be adjusted by means of moving the operating-pin closer to, or away from, the centre of the driving-wheel. The sketch, (Fig. 1) is self-explanatory, and no instructions will be needed by "L.B.S.C." readers. The body of the pump is easily made from ½-in. bore brass tubing, about 2 in. long, with end-fittings turned-up from brass or bronze. The piston may be of any suitable material, dural being excellent, and is packed with a few strands of graphited yarn. The piston should not be too good a fit in the tube. The valve-box is lifted straight from "L.B.S.C." with suitable connections fitted to take the rubber hose used—no pressure being used in the system, tight push-on connections have been found quite satisfactory. The box is attached to the lower fitting of the pump by a short piece of ¼-in. brass tubing, brazed or soldered into both. The piston of the pump should be shaped as shown, with a ¼-in. spigot on the underside, to avoid closing the port if at any time the full stroke of the pump should be used.

The Drive

As shown in the sketch, Fig. 2, a small pulley about 1½-in. diameter (dural) was turned and bored a good fit on the countershaft, and locked to this by means of a small grub-screw. The large pulley (also dural) was made from a scrap piece of sheet about $\frac{5}{16}$ in. thick. This was bored and pressed on to a piece of round brass

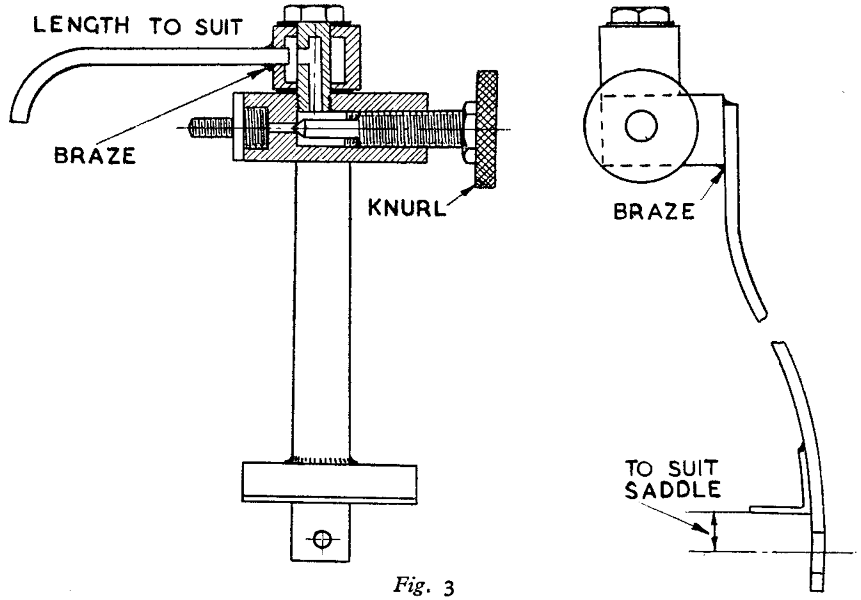


Fig. 3

rod, $\frac{3}{4}$-in. diameter, drilled for stub-shaft and bored out each end to receive a small ball-race, pressed in. Both pulleys had a V-groove turned in them, $\frac{3}{16}$-in. depth, and the belt is a piece of curtain-spring as sold at Woolworth's. The correct length and tension was found by trial and error, and the ends then joined by forming a hook in each end of the spring, these being closed-up into eyes after being hooked one into the other. This "belt" runs silently and grips well on the dural used for the pulleys. The large pulley has a slot cut in it, as shown, so that the stroke of the pump can be varied from zero to full-stroke at will, in a similar way to pumps on some types of flash-steam plants.

The Tap

This also is a very simple affair, consisting of a brass body about $1\frac{3}{8}$ in. long, brazed to a stand of flat-section brass; $\frac{1}{8}$ in. × $\frac{5}{8}$ in. was used in my case, and attached to the saddle by a single $\frac{1}{4}$-in. B.S.F. bolt, the saddle being tapped to receive this. (Fig. 3.) To keep the stand upright, but still making it instantly detachable, a piece of $\frac{3}{8}$-in. × $\frac{3}{8}$-in. × 3/32-in. angle was brazed to the stand in the position shown. Although this point of attachment is useful for turning, with the pipe following the tool along the work, it will probably be found advantageous to provide an alternative tapping for the screw somewhere on the headstock, so that the fluid may be kept flowing on to a slotting-cutter, end-mill or other milling tool, while the work is traversed across the tool. The back-gear guard has proved a convenient point on the Myford. The body of the tap is drilled right through 3/32 in., and one end opened up for $\frac{1}{4}$ in. and tapped $\frac{1}{4}$ in. × 40 to receive an adapter for piping, the other end being opened-up to 5/32 in. for $\frac{7}{8}$ in. depth, and D-bitted to $\frac{5}{16}$ in. depth. A $\frac{3}{16}$-in. × 40 tap is then run into this hole for $\frac{5}{8}$ in. depth, to take the spindle. It has been found an unneccessary complication to use a gland, but one could be used if desired. At a distance of $\frac{1}{2}$ in. from the $\frac{1}{4}$-in. tapped-end, drill in to break into the cross-hole and tap $\frac{1}{4}$ in. × 40 for the outlet pipe. This may be attached by a plain union, but a "banjo fitting" as shown, has proved most useful, as it forms a swivelling pipe connection, and the fluid may be directed where it can do most good. The spindle was made from stainless steel, furnished with a knurled operating wheel. with a 45 degrees cone at the other end, and threaded to suit the body. The end of the spindle adjacent to the cone should be reduced to $\frac{1}{8}$ in. for about $\frac{1}{2}$ in., to allow the fluid to flow freely.

(*Continued on page* 313)

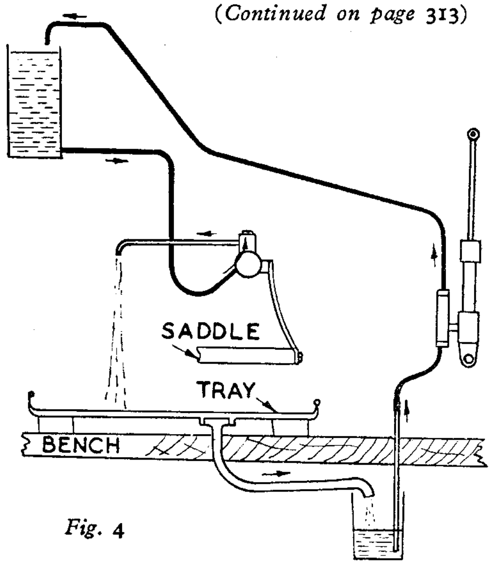


Fig. 4

A Model Engineering Revival at LEICESTER

THE spirit of model engineering has flourished vigorously in the City of Leicester for many years past, and the writer has memories of a visit he paid to the then existing society in very pre-war days. War-time years were a blank period with many societies, and Leicester was no exception to the rule, but a great revival has now taken place. The President, Mr. F. W. Chapman, one of the pioneer pillars of Leicester model engineering has a heartening story to tell.

In early 1946 he called the remnants of the old society together to set things going again, and some sixty members and visitors responded to the invitation. The old-timers at the meeting only numbered twenty-five, but at the close of the proceedings everybody present had signed on. Mr. Dallaston, one of the Joint Hon. Secretaries, then proposed an exhibition, and the idea caught on at once. During the summer months preparations were made, and at the end of October the show opened its doors. It was an immense success. Mr. Dallaston himself had borne the burden of most of the preliminary work, but he says that when the day came to get the show set up, he had more willing hands than he could find work for, an enthusiasm he had not previously experienced. Mr. F. W. Chapman, the Chairman, and Mr. J. Walker, the other Joint Hon. Secretary, were especially helpful.

The exhibition was opened by Alderman David Bentley, J.P., a well-known Leicester engineer, who was much impressed by the 200 exhibits on view. Mr. W. H. Franklin and Mr. R. H. Fuller, of Messrs. Bassett-Lowke Ltd., kindly undertook the arduous task of judging. Visitors came from all parts, even from as far afield as Liverpool, and on the Saturday a queue extending to some 300 yards testified to the public interest which the show aroused.

Photograph by courtesy of "The Leicester Mercury"

C. H. Horrocks, winner of "The Leicester Mercury" cup with his $\frac{3}{4}$-in. scale N.E. 4-4-0 *locomotive*

A very welcome visitor was Mr. Charles

P. Glover's model fairground

Meadows, of the Malden Society, who rendered much valued service as a driver on the passenger track. In addition to this he attended several meetings of the society and gave some much appreciated lectures. Mr. Meadows kindly prepared a report on the exhibition, from which we make the following extract. He writes :—

A group could always be found around the 1¼-in. scale steam-driven roundabout, entered by S. and R. Taylor (father and son respectively), which ran almost continuously during the show. This model, realistic in performance and appearance, is built in numbered sections as in the prototype. Another fairground exhibit which deservedly attracted much interest was the group entered by Mr. P. H. Glover ; that comprised a roundabout, another circular ride called "Noah's Ark," a cake-walk, swings, and the vehicles which, in full scale practice, are used for the transport of the equipment, including two traction engines.

Mr. A. Wallis had almost an exhibition to himself ; one of his entries, a two-cylinder compound undertype engine, driving a countershaft from which various others were driven.

Road transport was well represented by various traction engine entries, tramcars and omnibuses, Mr. Riley's "M.E." traction engine and an unfinished 1½-in. scale model Marshall 8 h.p. single-cylinder traction engine, built by Mr. P. T. Gutteridge from scrap, and the two ⅜-in. scale tramcars loaned by Mr. E. Thornton, of the Coventry S.M.E., were outstanding in their class.

The many locomotive exhibits were so uniformly good that it is possible to mention only a few, such as Mr. Horrocks' 3½-in. gauge 4-4-0 North Eastern, Mr. Oram's 3½-in. gauge L.M.S. Pacific, Mr. Roger's 5-in. gauge 0-4-0 "Ann of Holland," and the 0-6-0 3½-in. gauge heavy industrial tank engine entered by Mr. Baker, of Burslem. Mention must also be made of Mr. Chapman's 6-in. gauge G.W.R. Atlantic, which was in steam during the greater part of the show and ran under the professional eye of Mr. S. Taylor, on the 60-ft. portable track installed in a smaller room.

In the marine section, Mr. S. P. Tilley's 6-ft. Yarmouth drifter and Mr. A. M. Welter's U.S. torpedo patrol boat, fresh from their triumphs at THE MODEL ENGINEER Exhibition, were the outstanding examples ; they were loaned by their owners through the Northampton Society. Local talent was represented by Mr. Wallis's petrol-engined cabin-cruiser, Mr. Horrock's two launches and Mr. S. Parker's coaster, with its alternative power plants.

The principal awards were as follows :—

"Leicester Mercury" Cup.—C. H. Horrocks, ¾-in. scale N.E. 4-4-0 tender locomotive.

President's Prize.—A. Wallis, 1½-in. scale undertype compound steam engine.

President's Prize for Beginners.—J. Briars, ¾-in. scale L.M.S. 4-6-0 5XP class locomotive.

Locomotive Models Cup.—Mr. Lee, 1¼-in. gauge 4-6-4 N.Y.C. Hudson locomotive, "Josie."

General Models Cup.—S. and R. Taylor, 1¼-in. scale steam driven roundabout, galloping horses.

Ship Models Cup.—S. Parker, model galleon "Golden Hind."

Aircraft Models Cup.—Mr. Marsh, 6-c.c. petrol engine airplane, "Hermione."

Messrs. Woodcraft Special Prize.—E. Thornton, ⅜-in. scale model Bradford Tramcar, No. 232.

The Society desires to express its thanks to the Northampton, Coventry, Derby and Grimsby Societies, and to Messrs. Goodwin Barsby Ltd., for the loan of models ; and to all those who helped to make the exhibition a success, in particular those hard-working wives of members who so capably handled the refreshment service.

Cutting-Oil for a Small Lathe

(*Continued from page* 311)

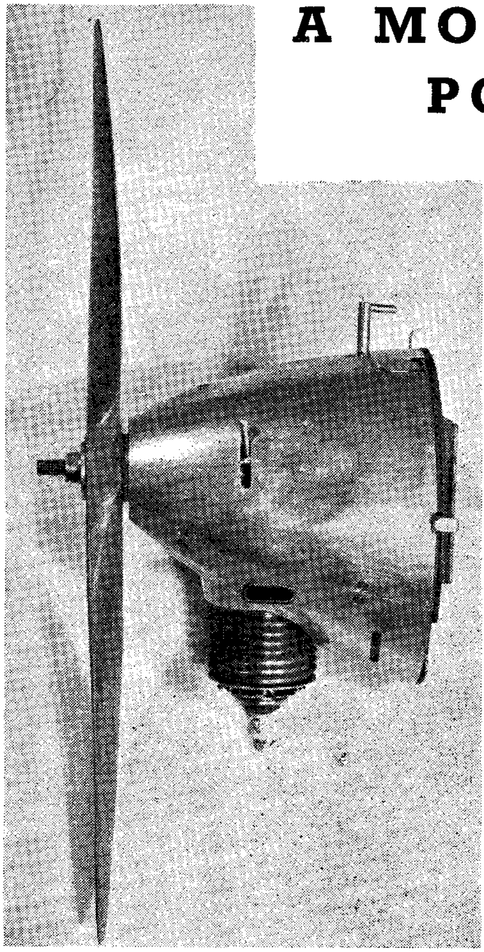
The System

This is arranged to feed by gravity, and any suitable containers may be used. (Fig. 4.) It is an advantage, however, to be able to see the contents of the "sump," and in my case, a square glass pickle-jar, of about a quart capacity, was used, and was secured under the bench by a steel clip around its neck. A ¼-in. hole, drilled through the bench immediately above, enabled a piece of piping to be pushed through into the jar until its cross-nicked end almost touched the bottom, and forms the suction connection. About three inches were left above the bench, and were bent over and joined to the suction end of the valve on the pump, by means of windscreen-wiper tubing. This flexible tubing is necessary, as the valve rocks slightly as the pump oscillates. The header tank consists of a cocoa-tin with a short piece of ¼-in. tubing soldered into the side about ½ in. from the bottom, a piece of the rubber hose being pushed on to the tubing and led to the tap. (It is not desirable to have the suction directly from the bottom of the tin, as any swarf or dirt in the tin would soon choke the small hole.) Do not forget to use sufficient tubing here to enable the alternative tapping on the headstock to be used, also to enable the tap to follow the full length of the lathe traverses. The system is completed by a drain pipe from the lathe tray, *via* a gauze-covered outlet in the tray, into the glass sump, and another from the pump outlet to the top of the header tank. (Rubber hose.)

When the tap is opened, with the header-tank filled, the fluid will run *via* the work into the tray, from where it will drain into the glass sump. The pump will then draw the fluid up and pump it back to the header tank, from where it is used again. It will be found that the pump will very soon pick up the fluid from the sump without priming being necessary, though this may have to be done when first trying out the system, with all pipes, etc., bone dry.

A MODEL AIRCRAFT POWER UNIT

By G. F. Kington



AFTER several years' activity in the model engineering field, I attempted my first petrol engine, which proved successful after an enormous expenditure of time spent in facing up the joints and opening out ports. Eventually, I had a reliable and easy-starting engine, which led a useful, and not entirely uneventful life, driving a small hydroplane over the local pond.

Among the people I demonstrated the engine to was M. Garnett, then Secretary of the Bristol Model Aero Club, and, perhaps rashly, I fell in with his suggestion to make another engine for model aircraft use.

A start was made on the Hallam 9.8-c.c. engine, which was the only one on the market at the time (Easter, 1945), and in the interests of such conflicting things as lightness, ease of manufacture, easy starting, reliability without high revolutions, model aircraft operation, etc., etc., many modifications were incorporated.

If I can repeat that this was my second attempt at a petrol engine, although I was an ardent student of Mr. Westbury's ideas, perhaps the following brief catalogue of what was done, and what eventually happened, will be of interest to more experienced modellers.

Cylinder and Crankcase Casting. The mounting lugs were cut off, and the casting was shaped down to as near a $\frac{1}{16}$-in. uniform thickness as possible.

Rear Crankcase Cover. This was turned down to approximately 0.050 in. uniform thickness, and the cast petrol tank attachments deleted.

Front Crankcase Cover and Bearing. This was also turned down all over, the radial supporting webs being removed, and replaced by a turned dural cone—0.020 in. thick, pressed home in the cover recess, and over the bearing. The bearing itself was bushed with phosphor-bronze.

Crankshaft. Turned from solid 80-ton Ni-chrome steel, chromium plated and ground. The shaft itself was bored out and partly plugged with a dural block, incorporating an oilway coming out halfway down the bearing. The shaft was fitted with a thrust race.

Cylinder Sleeve. Turned from cast iron and ground ; this was made a shrink fit in the casting, the ports being left as per drawing.

Piston. This was an experiment in construction which appears to have possibilities. No rings were used, and the piston was first turned from mild steel, oversize, with $\frac{1}{16}$-in. walls and a turned symmetrical dome. A suitable forming tool was made, and the head was shaped to the normal deflector top, with a roughly hemispherical lower combustion space. The gudgeon-pin bosses were lengths of mild-steel tube welded on the inside, and after these had been bored, the piston was turned down to 1/32 in. uniform wall thickness, and lapped into the cylinder.

Gudgeon pin. Fully floating, made from steel tube and fitted with dural end caps.

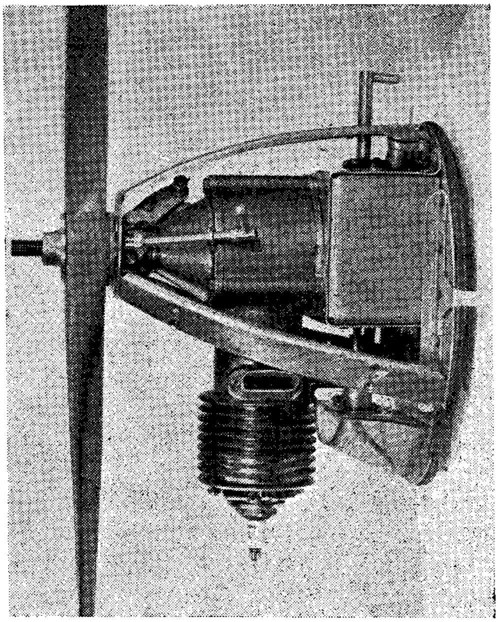
Connecting-rod. Machined from dural bar, with I-section rod, phosphor-bronze bush in the big end but unbushed at the little end.

Cylinder-head. Turned from dural bar, with horizontal fins—spark plug and combustion space offset towards exhaust port.

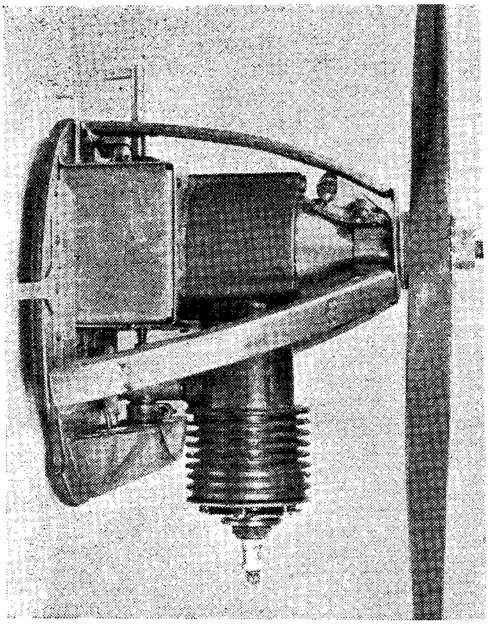
Contact-breaker. Pivoted rocker type, operated by cam on back of airscrew washer, and with the points well back from the front end of the bearing.

For test running, the engine was mounted by extending the three crankcase bolts backwards, and initial trials, using a standard induction pipe, and needle valve with suction tank were satisfactory. The engine started fairly easily, and ran for up to one minute without slowing, driving a 14-in. diameter, 8-in. pitch airscrew at 5,500 r.p.m.

For installation in the aircraft, the "knock off" type mounting was decided on, with the



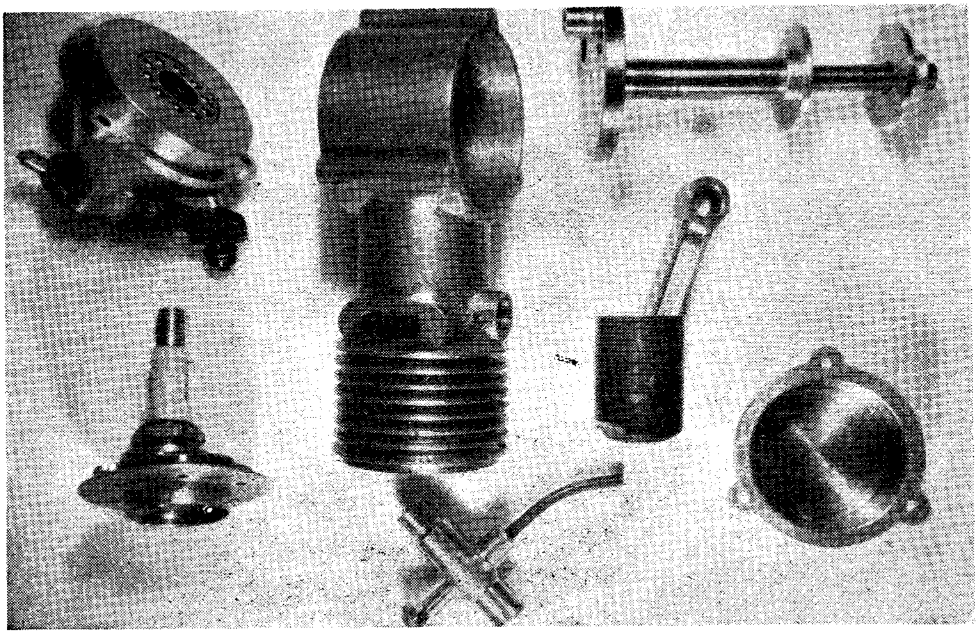
Unit from port side—cowling removed



Unit from starboard side—cowling removed

unit held by rubber bands. In order to avoid excessive strain on the crankshaft if the engine were knocked off, a backplate about $3\frac{1}{2}$ in. diameter was called for, but this would have meant that the petrol tank would be hung out in the airstream, and so eventually a compromise was decided on, with the backplate dropped sufficiently to allow a shallow tank to be incorporated inside the proposed cowling lines.

(*Continued on page* 317)



Engine "bits and pieces"

LATHE "ADEPTATIONS"

By Geo. E. Sheard

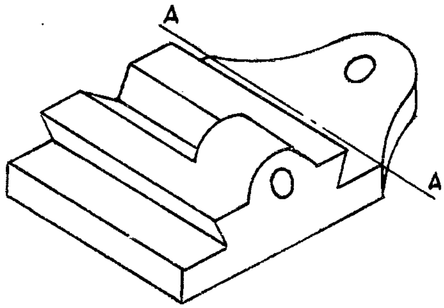


Fig. 2

IT may be remembered that in my article on "Tool Boxes for Small Lathes" (THE MODEL ENGINEER, October 26th, 1944), I mentioned that in order to fit the tool-box to the "Super Adept," it meant dispensing with the top slide. As this particular part has been floating around the bench since the conversion, it was decided to make use of it ; the most obvious thing for it to become being a vertical slide to fit either lathe.

The only raw material required is a piece of $1\frac{1}{2}$-in. $\times$ $1\frac{1}{2}$-in. angle-iron, $2\frac{5}{8}$ in. long ; this was set up on the shaper and machined all over, dead square, to $1\frac{1}{4}$ in. $\times$ $1\frac{1}{4}$ in. $\times$ $2\frac{1}{2}$ in. One side was then sawn down to $1\frac{3}{8}$ in. long, four $\frac{3}{16}$-in. holes were drilled in this, together with three $\frac{1}{4}$-in. holes in the long side. Figs. 1 and 3 show the position of these holes. The slide ways were

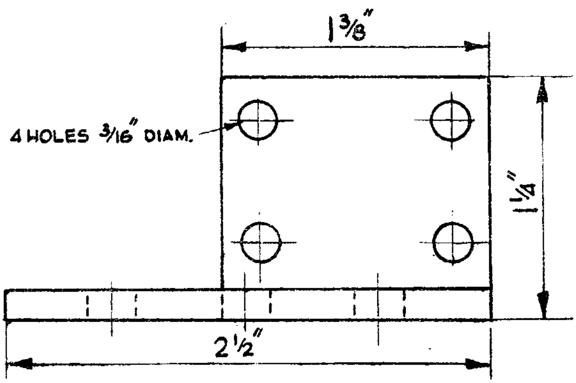


Fig. 1

then removed from the top-slide and the original holding-down lug sawn off as indicated in Fig. 2, leaving the base approximately $1\frac{3}{8}$ in. square. In addition, the V's were lightly skimmed up with the shaper tools *ground* to the correct angle this latter operation was necessitated by the fact that the V's were bow-legged, in fact, all these parts on both lathes were in the same condition, and were thus treated in the same manner. The angle-plate was then set up on the cross-slide of the lathe in the position occupied by the base turret, the rear stud on cross-slide being removed and a set-screw used in its place. The vertical slide-base is then lined up square with the lathe bed, and secured with a tool-maker's clamp ; the whole was then removed, and a $\frac{3}{16}$-in. drill "poked" (shades of "L.B.S.C.") through the four $\frac{3}{16}$-in. holes. This gave the centres of the tapping holes. These were then drilled and tapped for No. 1 B.A. screws, the base being finally affixed to the angle by four "fillister"-head screws. When the slide is set up on the lathe, a very substantial job results, although on the ordinary "Adept" one can only get in one holding-down screw, nevertheless, the result is just as satisfying, and the use of such a fitment will be readily perceived by other owners of these lathes.

Fig. 4 shows the method of drilling the vertical slide work table, four No. 1 B.A. holes are tapped in the positions shown.

On both lathes, the rough cast-iron hand "knobs" have been replaced by balanced ball-handles ; the tailstock locking-screws have been treated in a like manner, these latter additions make for easier manipulation of the machines.

The method of oiling the headstock bearings was very unsatisfactory, being simply two minute holes, down which one was supposed to inject oil. This was found to be next to impossible, owing to the air trapped in the hole. In order to overcome the "no-lubrication" system, the holes were opened out to $\frac{1}{8}$ in. half-way down and a pipe built up, as in Fig. 5. With a large oil receptacle at the top, this provides very efficient

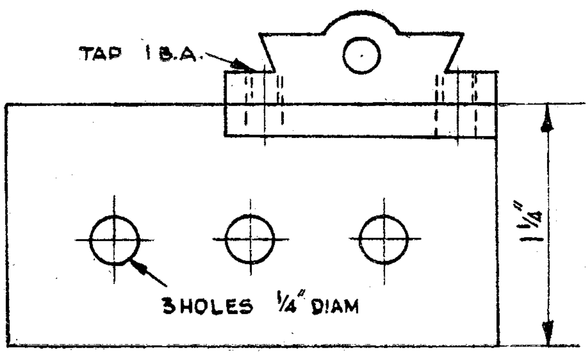


Fig. 3

lubrication, and with the bearings adjusted very fine, both these small machines can now be really called lathes.

By experiment, the best manner to drive these lathes is with the countershaft below the bench, and as long a drive as possible. The machines are each mounted upon a special bench which was made for the purpose from 9 in. × 3 in. planks on the base of an old sewing machine,

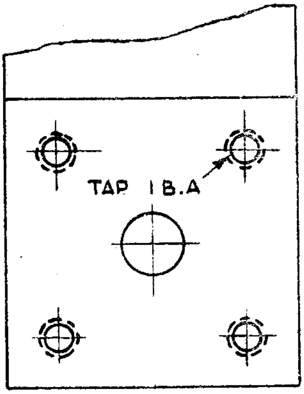


Fig. 4

the main shaft runs underneath, down the centre; this drives the two lathe countershafts and the drill and grinder countershaft. Two

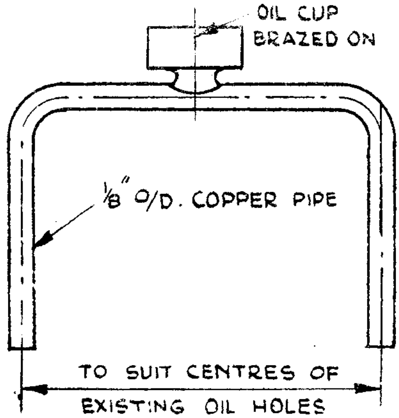


Fig. 5

tin-plate trays, 10 in. × 18 in. × 1 in., were obtained, and with suitable holes cut for the belts, complete the set up.

As an indication of the capacity of the "Super Adept," in its improved form, a two-step V-pulley, the same size as its own headstock pulleys, was turned from a solid piece of cast iron; this was roughed out with hand tools and finished with the compound rest.

A Model Aircraft Power Unit

(*Continued from page* 315)

The engine was bolted on to a 22-s.w.g. box bent up from sheet dural with open sides and top and bottom, braced by diagonal 24-s.w.g. dural angle section struts on either side. This did not prove satisfactory, as the mounting distorted during starting operations, and the two diagonal struts fractured under the vibratory loads. Finally, the closed box structure shown in the photographs was built up, and this has proved satisfactory to date.

The backplate was originally 18-s.w.g. dural, bit this did not prove to be stiff enough, and it was reinforced, firstly by the two 20-s.w.g. angle stiffeners shown in the photographs, and then by a $\frac{1}{8}$-in. thick plywood plate behind.

In order to reduce air resistance, it was decided to cowl in most of the engine, leaving only the cylinder and spark plug exposed. A wooden block was carved to the inside shape of the cowling, and plaster casts made for the three cowling panels required, with joints at the top centre and lower quarter points. The 26-s.w.g. aluminium cowlings were partly pressed to shape and partly beaten and rolled, eventually producing the required contours. The cowling frame consisted of three U-section members, attached to the backplate and to the ring at the front, where a vertical slot was provided to facilitate extraction of the crankshaft. The cowlings were attached by twelve 8-B.A. countersunk head screws, tapped into blocks on the inside of the cowling members.

The petrol tank was built up from celluloid to the shape of the lower cowling, which was slotted so that the petrol level could be observed. The tank was filled through a long flexible tube ending in a spring-loaded flapped hole at the top of the backplate. The needle valve was extended up through the engine mounting, and out through the top of the cowling, where it was fitted with a short lever. A fibre guide was fitted to the top of the engine mounting, and this served also as an adjustment for the tightness of the valve operation.

The contact-breaker had been designed to fit inside the cowling, and the only additional modification was to fit a light rack and pinion, so that the advance and retard gear could be operated without risk of slicing from the airscrew.

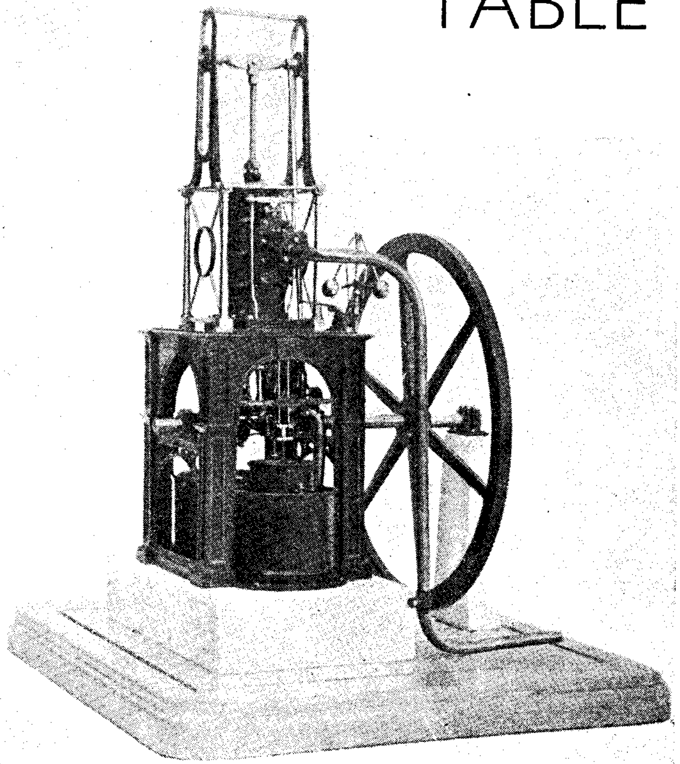
The photographs show the engine complete, also bits and pieces, port and starboard sides of the unit, with and without cowling. Ignition wiring has been deleted to give a clearer view of the structure, but the condenser is fitted inside the mounting box, whilst coil and earth leads are led out through the backplate into the fuselage. The airscrew shown is a 14-in. diameter, 8-in. pitch metal "Duraprop," still lacking a spinner, as the final airscrew type has not yet been finally settled.

The whole unit weighs 19.05 oz., made up as follows :—

Engine	13.3 oz.
Engine mounting and cowling ..	2.25 oz.
Airscrew	3.5 oz.

The aircraft used with the unit at present is a pylon parasol duration monoplane, wing span 80 in., and flying weight 8 oz. Wing loading is 10 oz./sq. ft., and the flight performance leaves little to be desired.

A MODEL MAUDSLAY TABLE ENGINE



by

L. G. BATEMAN

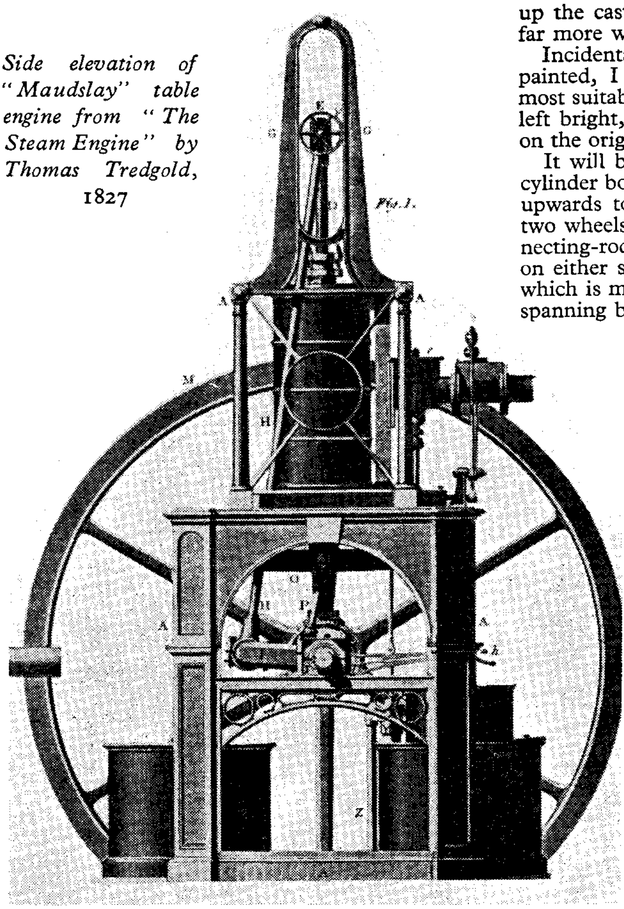
TORONTO S.M.E.

A BRIEF DESCRIPTION OF THIS ENGINE APPEARED IN "THE MODEL ENGINEER" MARCH 7th, 1946 ISSUE. IN THIS ARTICLE MR. BATEMAN SETS OUT TO DESCRIBE THE ACTUAL BUILDING OF HIS EXHIBITION MODEL.

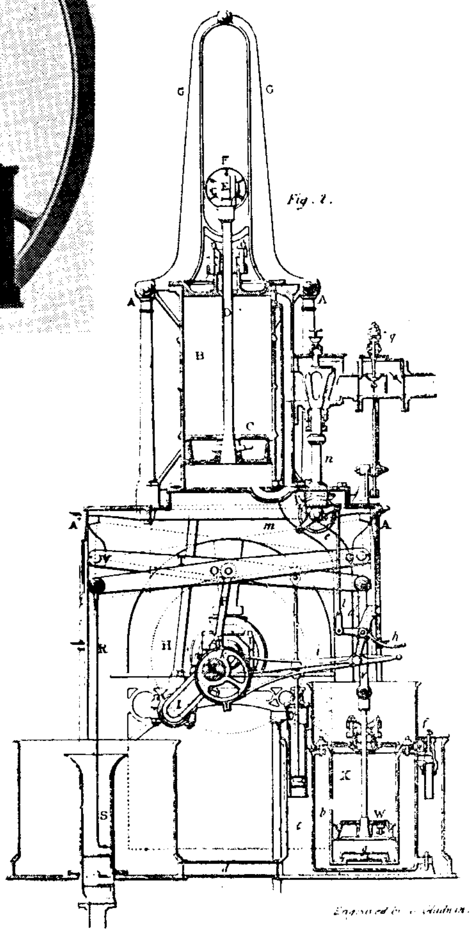
THERE is no doubt that for creating interest at a model engineering exhibition there is nothing better than a working model. This was particularly brought home to me at the exhibition that the Toronto Society of Model Engineers put on in April, 1942, at a time when my interests were held by model speedboats, but when also the war had put an end to the running of them here.

So I thought of building an exhibition model and had had for some time a liking for a table-engine, possibly started by seeing the picture in THE MODEL ENGINEER of January 4th, 1934, of the model built by Mr. R. W. Wood. I then started to search, first in the volumes of THE MODEL ENGINEER and then in the Toronto Reference Library. I already had a cross-section of a model table-engine in "A Short History of the Steam Engine," by H. W. Dickenson, but it seemed rather complicated and the one drawing hardly adequate, then eventually I came across this same cross-section, but with two other views, side and end elevation, in "The Steam Engine," by Thomas Tredgold, 1827. Here my search ended, as the drawings were so excellent that I felt sure I could not expect to find better, and so despite the great amount of work obviously going to be involved in making such a model, I started making sketches. The book belonged to the Reference Library, and so could not be borrowed. I soon tired of sketching and decided to ask if an exception could be made and the book borrowed long enough to have photostats made. Having explained to a librarian what I wanted and what a photostat was, I was most surprised on being told, "Oh, we can photograph the drawings for you," and they did, most excellently and made me enlargements that gave me the drawings, as near as no matter to a scale of $\frac{3}{4}$ in. to 1 ft. These I used as working drawings. Thus the model was started and occupied about eighteen months of spare time. It was to be a working model in all respects and as true to scale as possible.

Being quite new to historical models, I was not sure exactly which parts would be bright and which would be painted, etc., and if painted, in what colours, so I decided to impose on the late



Side elevation of "Maudslay" table engine from "The Steam Engine" by Thomas Tredgold, 1827



Cross section of "Maudslay" table engine from "The Steam Engine" by Thomas Tredgold, 1827

Mr. H. O. Clark, of Norwich, and to write for his advice. It happened that he was known to and in correspondence with one of the Toronto Society of Model Engineers' members, Mr. C. Barker, from whom I obtained his address. I received a very long, encouraging and exceedingly helpful letter from Mr. Clark and, amongst other things, he assured me that the taper plug-cock type of valve shown in the drawings of the engine was not typical and that a slide valve would be more so, and I was able to change to a slide-valve with very little alteration.

It is one of my regrets that Mr. Clark died before I had sent him photographs of the completed engine, which were delayed by war-time difficulties.

In making the model no castings have been used, instead parts have been built up by silver soldering, by which means I believe I can make a better and cleaner looking part quicker, dispensing with the pattern work and not having to persuade a foundry to go out of its way to make unusually fine castings in times of difficulty. The table, for instance, is built up of approximately 110 separate pieces of brass. This sounds rather formidable, but to have made patterns with all the fine details of mouldings, etc., and to have cleaned up the castings would, I am sure, have entailed far more work and have been less truly to scale.

Incidentally, when a part of the engine is to be painted, I have no hesitation in using a metal most suitable to my purpose, but where it is to be left bright, then it must be of the same metal as on the original as far as possible.

It will be seen from the photographs that the cylinder bore stroke, standing on the table, drives upwards to the cross-head, which is guided by two wheels running in guides, and that the connecting-rods descend from the cross-head, one on either side of the cylinder, to the crankshaft, which is mounted on bearings carried on bearers spanning between the table legs. The crankshaft

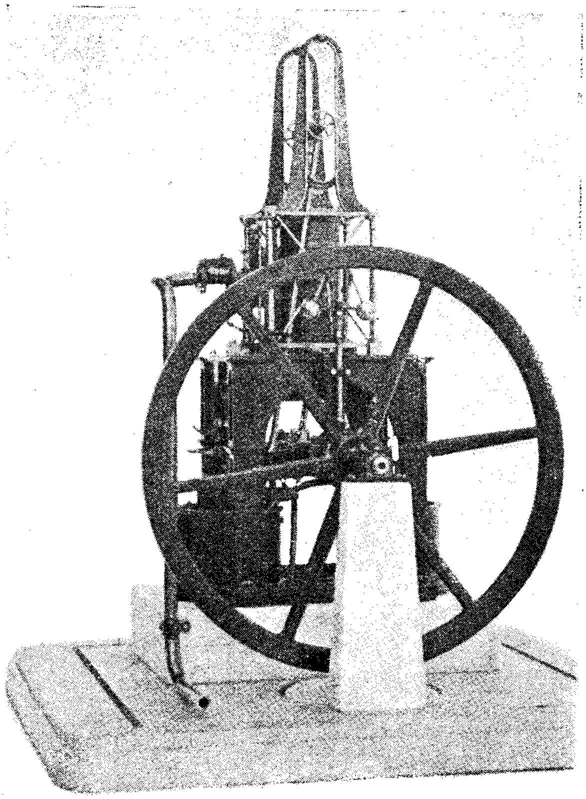
has two main throws for the connecting-rod big-ends, and between these throws there is a smaller throw in the same plane and off-set in the same direction from the crankshaft axis as the main throws.

On this minor throw are two short connecting-rods and the eccentric. These two short connecting-rods drive beams that in turn operate the pumps. The circular tank, between the table legs on the left, seen from the side of the engine remote from the flywheel, contains the pump drawing cold water from the well, pond or river, and the tank on the right contains the jet condenser, air pump, hot-well and boiler feed pump.

As the eccentric is mounted on a portion of the crankshaft that is off-set from the crankshaft axis, the movement of the eccentric rod is the vector sum of this off-set and of the eccentricity of the eccentric.

The eccentric rod is gab-ended and may be lifted off the pin it drives and the valve then operated by hand. The valve is operated from the eccentric rod through two rock shafts with bell cranks and a connecting link, and two rods passing one on either side of the valve chest to a cross-head attached to the valve-rod which passes out of the top of the valve chest through a stuffing box.

Due to the flywheel being to scale, it is rather too light to make for really steady running at the slow speed that would be proper, though the model will run at about 70 r.p.m. on compressed air, with the governor doing its best to keep the speed steady.



A side view of Mr. Bateman's model Maudslay table engine

It was necessary to make all the nuts and bolts, as none could be bought and the threads used are a mixture of 8-B.A., the smallest American machine screw size, namely number 0-80, which is 0.60 diameter by 80 t.p.i, and finally a watchmaker's size of 0.036 diameter, pitch unknown but very fine, for bolts and nuts of $\frac{1}{16}$ hexagon. If one of these is dropped on the floor it is much quicker to make another than to search for it.

The engine is mounted on a block of Italian marble suitably grooved to represent stone blocks. I am not satisfied with this as a "model stone," but so far have failed to find anything better. Perhaps someone who reads this could help. The texture of the marble is about right, but it has markings that are undesirable and run from block to block and so make it obvious that it is really all one piece and not a number of small blocks. So far I have had no luck with plaster and cement and sand.

The model is painted dark green and orange, the colour being suggested by Mr. Clark, and the success of the painting depended very largely on the use of a "Pasche" air-brush, such as used for show cards to spray the enamel, and on very considerable rubbing down. With such an air-brush the enamel can be put on very much more thinly than is possible with a brush, so thinly if desired that it is only a "mist" coating. An infra-red drying lamp bulb was used to help dry the enamel quickly before dust could settle on it.

The building of this engine and the preliminary search was the beginning for me of an interest in and study of the early history of the steam engine and of a determination to build a series of historically interesting steam models.

The second model of the series is also completed and is of the Easton and Amos Grasshopper engine in the Science Museum, South Kensington, and the third, of a Trevithick engine and boiler, also in South Kensington, is started.

I might say that, according to H. W. Dickenson (above), the table engine was patented by Henry Maudslay in 1807, and that the drawings I used appear to have been first published in "An Historical and Descriptive Account of the Steam Engine," by Ch. F. Partington, in 1822, in what is apparently the first book to be published dealing solely with the steam engine. They were engraved by J. Clement and are commented on for their excellence by Thomas Tredgold in the preface to his own work of 1827, in which he republished them.

QUERIES AND REPLIES

Enquiries from readers, either on technical matters directly connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a stamped, addressed envelope, and addressed "Queries and Service," THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the services of a specialist, or outside consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query; but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

No. 8004.—Engine for Flash Steam.
M.J.C. (Woolhampton)

Q.—Can you inform me where I can obtain plans for the construction of a flash steam engine.

My interest was aroused by an article in the September 6th, 1945, issue. I am not able to understand the drawing of the engine illustrated in that number; I wonder if you could throw any light upon the matter.

Do you know of an engine with rotary pistons and sliding cylinder heads? If such an engine existed, would it have any practicle use?

R.—The "Star," "Sun" and "Sirius" engines by Messrs. Stuart-Turner Ltd., of Henley-on-Thames, are suitable for working on flash steam and it is possible that the makers could furnish blue-prints of the designs. The essential requirements of engines to run on flash steam is that they should be of very robust construction to withstand high pressure, and built of materials which will withstand the high temperature of superheated steam.

In the case of the engine to which you refer, this is of the single-acting type, which avoids the possibility of packing-gland troubles, and steam admission and exhaust are controlled by separate piston-valves.

We do not know of any engine having the particular features of rotary pistons and sliding cylinder heads, and the practical value of such features is questionable, but it would be necessary to have full and exact particulars on the complete design in order to form a definite opinion as to its merits.

No. 8005.—Carburettor Details.
H.Z. (St. Athan)

Q.—I am building a miniature two-stroke petrol engine, $\frac{5}{8}$-in. bore and stroke.

I am unable to obtain data for a section atomising carburettor that I intend employing, and would be very greatly obliged if you could let me know the diameter across the narrowest section of the venturi, over the jet; also the size of jet to be used in conjunction with a taper needle control.

R.—A fairly safe rule for estimating the choke diameter of the carburettor is to make it not more than one-fourth the diameter of the engine cylinder; in the case of an engine of $\frac{5}{8}$-in. bore, therefore, this would be 5/32 in. The dimension refers to the throat or narrowest point of the choke, which should taper both ways from this point.

When using a tapered needle to control the jet, the size of the orifice is not critical, but it should not be made unnecessarily large, as this makes fine adjustment difficult. It is advisable to use a drill not larger than No. 70, or smaller than No. 80, for an engine of the size stated.

No. 8006.—Extractor Fan.
H.E.B. (Falmouth)

Q.—I am in the boat-building and repairing trade, and I have been working on an idea for cleaning wood shavings and sawdust, etc., from the bilges. I have finally hit on a large vacuum cleaner with a 3-in. or 4-in. suction pipe.

Could you give me some details and plans for the best type of fan, and the power required to drive it. The fan and engine would be stationary and the pipe taken to the boats.

R.—We regret that we cannot furnish you with plans or specifications for a fan suitable for your purpose, as machinery of the size indicated is entirely outside the scope of model engineering. Suitable fans for a vacuum cleaner, of large size, arranged either for motor or belt drive, are produced by several manufacturers, including Messrs. Keith Blackman Ltd., Mill Mead Road, London, N.17, Davidson and Co. (makers of "Sirocco" fans), Kingsway, London, W.C.2; and The Midland Fan Co. Ltd., 212, Aston Road, Birmingham.

No. 8007.—Hot Air Engines.
O.A. (Bradford)

Q.—We have been advised to approach you for information on hot air engines, as used in tropical climates. Our requirement, is for an engine to run a fan 18 in. diameter, with four blades, heat being supplied from a paraffin burner. It would be very much appreciated if you could give us any details of the above engine, with paraffin burner, and tubes, or suggest any makers to whom we may apply.

R.—A series of articles on the subject of hot air engines, containing numerous drawings and other illustrations, appeared in THE MODEL ENGINEER during the latter part of 1940. We

regret that we cannot supply copies of the issues containing these articles, but you might obtain access to them at a public library.

We can, however, supply blue-prints of a Heinrici type inverted vertical hot-air engine, of a size suitable for your purpose. These consist of two sheets, general arrangement and details respectively, price 2s. 9d. per sheet, post free. This engine is suitable for any method of firing, but no burner details are included. We regret that we cannot advise you of any other source of information or refer you to any firms manufacturing these engines.

No. 8008.—Atmospheric Gas Engine. E.D.B. (Macclesfield).

Q.—I have acquired a small horizontal type single-cylinder gas engine, and I am unable to find out how it works, as it appears to be short of one or two small parts. It is marked "System Schoenner," and appears to be of foreign origin. There is a "two peak" cam operating some sort of mixture valve on the cylinder head, and also a small jet-like port in the side of the cylinder which is only uncovered by the piston when the latter is nearing the end of its stroke (about half way).

I am at a loss to know how it works. Can you help me, or can any of your readers give a clue to the system on which it works? What puzzles me more than anything is the number of open holes in the cylinder and cylinder head, without any apparent means of sealing them against explosion. Bore of cylinder about 24 mm., stroke about 50 mm.

R.—The type of gas engine referred to is one which was fairly popular some fifty years ago, but is now entirely obsolete, being extremely inefficient and uneconomical. The use of flame ignition through an open port prevents any appreciable cylinder pressure from being used, and only about half the cylinder volume is effectively utilised. We regret that we cannot give you more definite details about this engine, but a detailed drawing of the engine would be helpful in this respect. Engines of the size you quote, usually horizontal with open cranks, and air-cooled, were at one time manufactured on the Continent, and sold in model shops.

Clubs

Guildford Model Yacht and Power Boat Club

The ninth annual general meeting of this club was held on January 23rd. Officers and committees for 1947 were elected. Reports of activity and successes for 1946 were received from the sailing and power boat sections. It was stressed that we number many active model engineers among our members, some actively engaged in model locomotive construction of varying size up to 5-in. gauge. A special effort is to be made to enrol the many other model engineers known to be busily occupied in various engineering activities in the district, to be followed by efforts to cater as fully as circumstances permit for the requirements of all sections. Our secretary (name and address below) will welcome enquiries from all interested persons, whether model yacht sailing, power boats and kindred craft, and general model engineering.

Hon. Secretary: W. E. Roberts, 52, Saffron Platt, Tilehouse Estate, Guildford.

Exmouth and District Society of Model Engineers

Our first annual general meeting was held at the Glenarchy Rooms, under the chairmanship of Mr. E. J. Thornton, on Monday, January 20th. The re-election of officers was as follows: Mr. E. J. Thornton, president; Mr. W. F. Holman, chairman; Mr. T. E. G. Holman, secretary; Mr. R. V. Riggs, treasurer.

The members agreed to organise a series of displays during 1947. Juveniles and elderly enthusiasts will help to provide the varied models to be shown. The first of these will be in conjunction with the Exmouth Rotary Club at the Pavilion, the date to be announced later. This young organisation (it was formed just twelve months ago) now has thirty-two members, their ages ranging from thirteen to seventy years of age. The society's policy is to co-operate with other youth organisations; its workshop, consisting of a lathe and a comprehensive equipment of requisite tools, is at the disposal of everyone, and together with lectures will be a useful attribute to all.

Hon. Secretary: T. E. G. Holman, "Belmont Cottage," Montpellier, Exmouth.

The Aylesbury Gang

The annual general meeting was held at headquarters, The Congregational Schoolrooms, High Street, Aylesbury, on December 16th, 1946, when the officers and committee for the ensuing year were elected, as follows: President, Mr. E. G. Eborn; Vice-president, Mr. E. Hasberry; Chairman, Mr. F. R. Forest.

Hon. Secretary: N. F. Southerton, "Astracot," Buckland Wharf, Bucks.

Tonbridge and District Model and Experimental Engineering Society

A general meeting was held on Saturday, January 11th, 1947. Twelve members and one visitor were present. Mr. E. M. Graville presided.

The chassis of Mr. C. C. Langer's G.W.R. "1000," and Mr. J. P. Mercer's "Hielan' Lassie," and the tender for the society's locomotive (beautifully made by Mr. O'Gorman), were also available for inspection.

Mr. Brooker gave a short talk on "French Polishing," and then demonstrated the process on different woods.

The meeting concluded with the presentation of a barometer, by Mr. H. H. Mills, on behalf of all members, to Mr. A. R. Judd, our former hon. secretary. Mr. Mills expressed our sincere gratitude to Mr. Judd for all he has done, and wished him every success and happiness.

Hon. Secretary: C. C. Langer, The Warren, Brenchley, Kent.